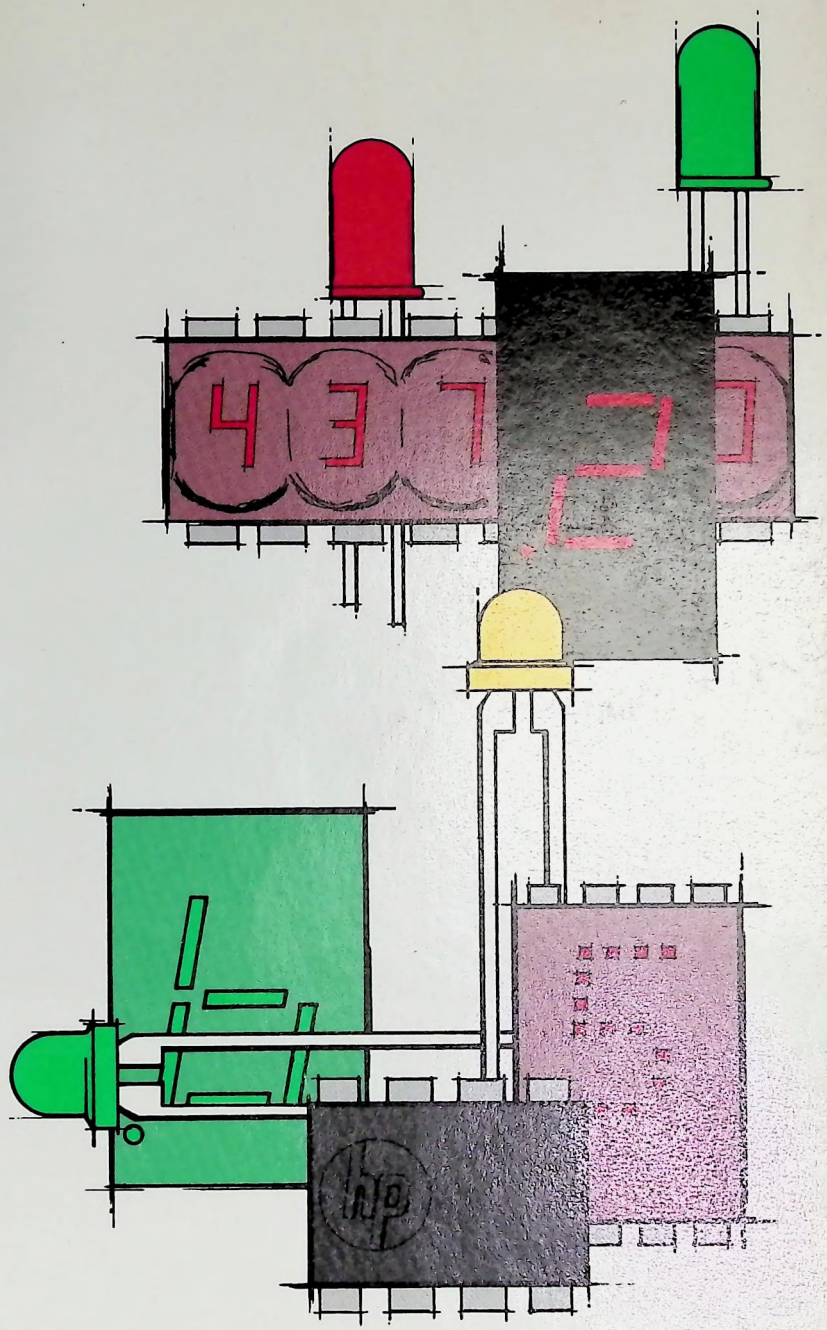
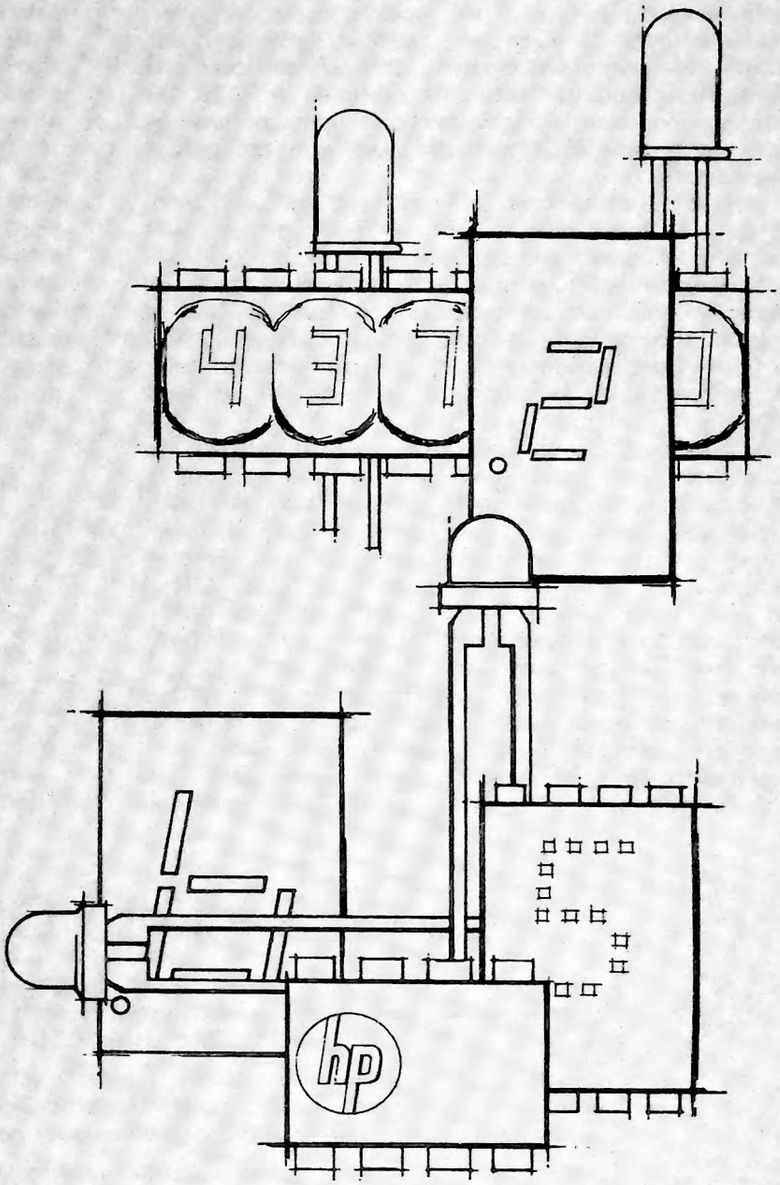
Hewlett
Packard
Components



Optoelectronics Designer's Catalog

1975



Optoelectronics Designer's Catalog

1975

Hewlett-Packard -- A Brief Sketch

Hewlett-Packard is one of the world's leading designers and manufacturers of electronic, medical, analytical, and computing instruments and systems, diodes, transistors, and optoelectronic products. From its founding in 1939, the company has conscientiously followed its basic philosophy of offering only products representing significant technological advancements.

To maintain its leadership in instrument and component technology, Hewlett-Packard invests heavily in new product development. Research and development expenditures traditionally average about 10 percent of sales revenue, and 1,500 engineers and scientists are assigned the responsibilities of carrying out the company's various R and D projects. As a result of this effort, about half of the company's current business is represented by products that were not in existence six years ago.

Hewlett-Packard is a well-established, multinational company that has controlled its growth so that expansion is financed generally from income on a pay-as-you-go basis. From its modest beginnings in Palo Alto, California, the company now has nine manufacturing plants in California, two in Colorado, and one each in Massachusetts, New Jersey, Idaho, Oregon and Pennsylvania. Hewlett-Packard overseas manufacturing facilities are located in Scotland, German Federal Republic, France, Japan, Singapore, and Malaysia.

However, for the customer, Hewlett-Packard is no farther away than the nearest telephone. There are 172 HP sales and service offices located in 65 countries around the world.

These field offices are staffed by trained engineers, each of whom has the primary responsibility of providing technical assistance and data to customers. A vast communications network has been established to link each field office with the factories and with corporate offices. No matter what the product or the request, a customer can be accommodated by a single contact with the company.

Hewlett-Packard is guided by a set of written objectives. One of these is "to provide products and services of the greatest possible value to our customers". Through application of advanced technology, efficient manufacturing, and imaginative marketing, it is the customer that the more than 28,000 Hewlett-Packard people strive to serve. Every effort is made to anticipate the customer's needs, to provide the customer with products that will enable more efficient operation, to offer the kind of service and reliability that will merit the customer's highest confidence, and to provide all of this at a reasonable price.

To better serve its many customers' broad spectrum of technological needs, Hewlett-Packard publishes several catalogs. Among these are:

- Electronic Instruments and Systems for Measurement/Computation (General Catalog)
- DC Power Supply Catalog
- Medical Instrumentation Catalog
- Analytical Instruments for Chemistry Catalog
- Coax. and W/G Measurement Accessories Catalog
- Diode and Transistor Catalog

All catalogs are available at no charge from your local HP sales office.

Hewlett Packard Optoelectronics

A decade of intensive solid state research, the development of advanced manufacturing techniques and continued expansion has enabled Hewlett-Packard to become a high volume supplier of quality, competitively priced LED displays, LED lamps, isolators, and photodetectors.

In addition to our broad product line, Hewlett-Packard also offers the following services: immediate delivery from any of our authorized stocking distributors, applications support, special QA testing, and a one year guarantee on all of our optoelectronic products.

This package of products and services has enabled Hewlett-Packard to become a recognized leader in the optoelectronic industry.

About this Catalog

This Optoelectronics Designer's Catalog contains detailed, up-to-date specifications on our complete optoelectronic product line. It is divided into four major product sections: LED Lamps, LED Displays, Isolators, and Detectors. It also includes an Index on optoelectronic Application Notes which are available from any of the Hewlett-Packard Sales and Service Offices listed on pages 118 and 119, and from any of the Distributors listed on page 120.

How To Use This Catalog

Three methods are incorporated for locating components:

- a Table of Contents that allows you to locate components by their general description,
- a Numeric Index that lists all components by part number, and
- a Selection Guide for each product group giving a brief overview of the product line.

How To Order

All Hewlett-Packard components may be ordered through any of the Sales and Service Offices listed on pages 118 and 119. In addition, for immediate delivery of Hewlett-Packard optoelectronic components, contact any of the world-wide stocking distributors listed on page 120 of this catalog.

Hewlett-Packard assumes no responsibility for the use of any circuits described herein and makes no representations or warranties, express or implied, that such circuits are free from patent infringement.

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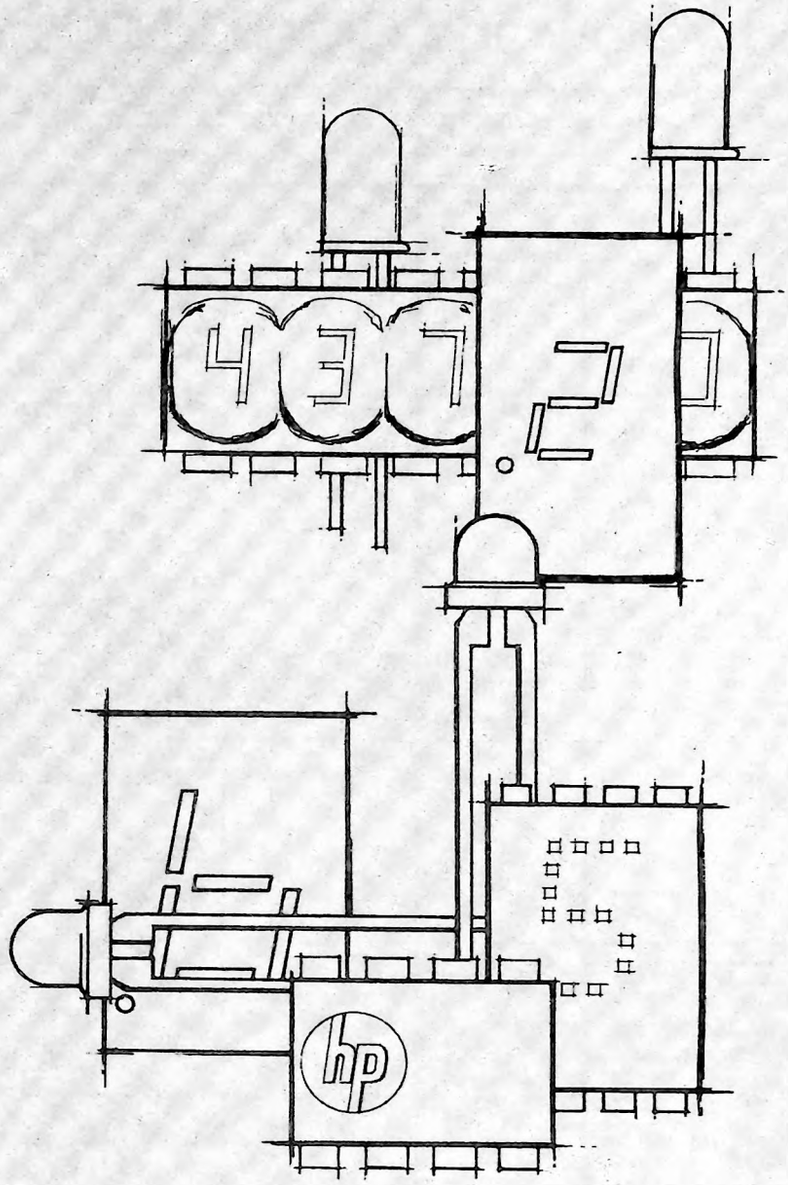

LED Lamps

Selection Guide 2

Red, Yellow and Green Lamps:

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Integrated Lamps:

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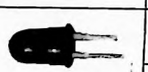
Commercial, 5082-4420 32

Panel Mounting Kit for T-1¾ Lamps, 5082-4707 33

Red, Yellow and Green LED Lamps

HEWLETT hp PACKARD
COMPONENTS

Device		Description				Typical Luminous Intensity	Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4650	High Eff. Red (635nm)[2]	GaAsP on GaP	Red Diffused	T-1¾; Plastic; Long, General Purpose Leads[3]	2.0mcd @ 10mA	90°	2.2 Volts @ 10 mA	4
	4655					4.0mcd @ 10mA			
	4657			Red Non-Diffused		12.0mcd @ 10mA	35°		
	4658					24.0mcd @ 10mA			
	4684	High Eff. Red (635nm)[2]	GaAsP on GaP	Red Diffused	T-1; Plastic; Long Leads[4]	2.5mcd @ 10mA	80°	2.2 Volts @ 10mA	6
	4550	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	T-1¾; Plastic; Long, General Purpose Leads[3]	1.8mcd @ 10mA	90°	2.2 Volts @ 10mA	8
	4555					3.0mcd @ 10mA			
	4557			Yellow Non-Diffused		9.0mcd @ 10mA	35°		
	4558					16.0mcd @ 10mA			
	4584	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	T-1; Plastic; Long Leads[4]	2.5mcd @ 10mA	60°	2.2 Volts @ 10mA	10
	4950	Green (565nm)[2]	GaP	Green Diffused	T-1¾; Plastic; Long, General Purpose Leads[3]	1.8mcd @ 20mA	90°	2.4 Volts @ 20mA	12
	4955					3.0mcd @ 20mA			
	4957			Green Non-Diffused		9.0mcd @ 20mA	30°		
	4958					16.0mcd @ 20mA			
	4984	Green (565nm)[2]	GaP	Green Diffused	T-1; Plastic; Long Leads[4]	2.0mcd @ 20mA	70°	2.4 Volts @ 20mA	14
 4403/4440	4403	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1¾; Plastic; Short Leads[3]	1.2mcd @ 20mA	75°	1.6 Volts @ 20mA	16
	4415				T-1¾; Plastic; Short, Bent Leads[4]				
4415/4444	4440				T-1¾; Plastic; Short Leads[3]	0.7mcd @ 20mA			
	4444				T-1¾; Plastic; Short, Bent Leads[4]				
	4480	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1; Plastic; Long Leads[4]	0.8mcd @ 20mA	120°	1.6 Volts @ 20 mA	18
	4483			Clear Diffused			80°		
	4486			Clear Non-Diffused					
4850/4855	4850	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1¾; Plastic; Long, Wire Wrappable Leads[3]	0.8mcd @ 20mA	95°	1.6 Volts @ 20 mA	20
	4855					1.4mcd @ 20mA			
4484/4494	4484				T-1; Plastic; Long Leads[4]	0.8mcd @ 20mA	120°		
	4494					1.4mcd @ 20mA			
	4487	Red (655nm)[2]	GaAsP on GaAs	Clear Non Diffused	T-1 (Low Dome); Plastic; Long Leads[4]	0.8mcd @ 20mA	120°	1.6 Volts @ 20mA	22
	4488					Guaranteed Minimum: 0.3mcd @ 20mA			

NOTES:
1. Total Angle Between Half Luminous Intensity Points.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 33.
4. PC Board Mountable.

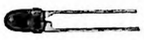
For Applications Information, see page 117

Red, Yellow and Green LED Lamps (Continued)

HEWLETT hp PACKARD
COMPONENTS

Device		Description				Typical Luminous Intensity	Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4880	Red (655nm) [2]	GaAsP on GaAs	Red Diffused	T-1¾; Plastic; Long, Wire Wrappable Leads [3]	0.8mcd @ 20mA	58°	1.6 Volts @ 20mA	24
	4883			Clear Non-Diffused			50°		
	4886			Clear Diffused			65°		
	4881			Red Diffused		1.3mcd @ 20mA	58°		
	4884			Clear Non-Diffused			50°		
	4887			Clear Diffused			65°		
	4882			Red Diffused		1.8mcd @ 20mA	58°		
	4885			Clear Non-Diffused			50°		
	4888			Clear Diffused			65°		

Integrated LED Lamps

Device		Description				Typical Luminous Intensity	Θ½ [1]	Typical Forward Current	Page No.
Photo	Part No. 5082-	Color	Integration	Lens	Package				
	4732	Red (655nm) [2]	Voltage Sensing IC integrated with GaAsP LED chip	Red Diffused	T-1; Plastic; Long Leads [4]	0.7mcd @2.75V	95°	13mA @2.75V	26
-4860	4860	Red (655nm) [2]	Resistor chip integrated with GaAsP LED chip	Red Diffused	T-1¾; Plastic; Long Leads [3]	0.8mcd @ 5.0V	58°	16mA @5.0V	28
-4468	4468			Clear Diffused	T-1; Plastic; Long Leads [4]		70°		

Hermetically Sealed LED Lamps

Device		Description			Minimum Luminous Intensity	Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No.	Color	Lens	Package				
	1N5765 JAN 1N5765 [5] JAN TX 1N5765 [5]	Red (655nm) [2]	Red Diffused	Hermetic/TO-46; Long Leads [4]	0.5mcd @ 20mA	70°	1.6 Volts @ 20mA	30
	5082-4420	Red (655nm) [2]	Red Diffused	Hermetic/TO-46; Long Leads [4]	0.5mcd @ 20mA	70°	1.6 Volts @ 20mA	32

For Applications Information, see page 117

NOTES:
1. Total Angle Between Half Luminous Intensity Points.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 33.
4. PC Board Mountable.
5. Military Approved and qualified for High Reliability Applications.

HEWLETT hp PACKARD

COMPONENTS

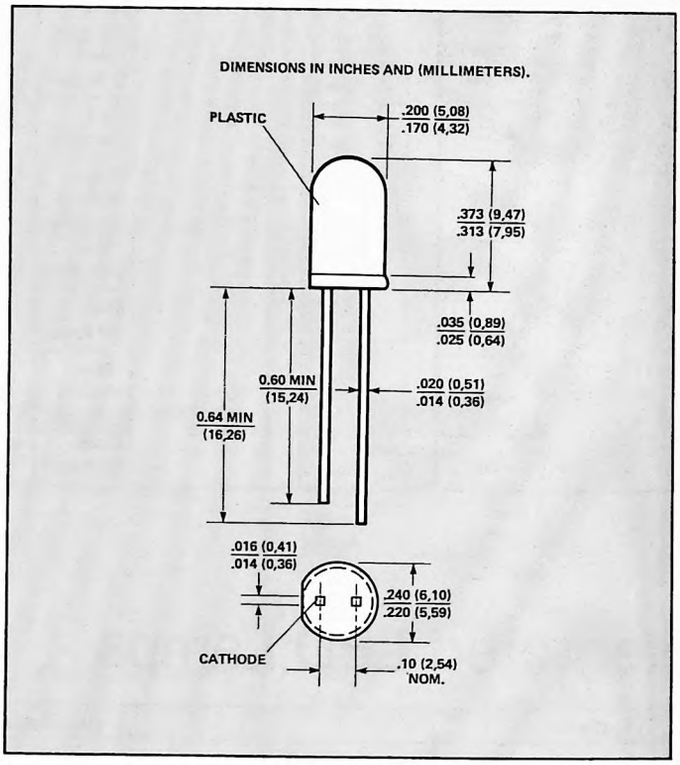
HIGH EFFICIENCY RED SOLID STATE LAMPS

5082-4650
5082-4655
5082-4657
5082-4658

TENTATIVE DATA NOVEMBER 1974

Features

- HIGH INTENSITY
  - 4 mcd Typical @ I_F = 10mA for wide-viewing angle applications.
  - 24 mcd Typical @ I_F = 10mA for narrow-viewing angle applications.
- POPULAR T-1¾ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- WIDE VIEWING ANGLE AND NARROW VIEWING ANGLE TYPES
- GENERAL PURPOSE LEADS
- NON-SATURATING LIGHT OUTPUT
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED



Description

The 5082-4650/4655 are Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diodes packaged in a T-1¾ outline with a red diffused lens, which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4657/4658 are Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diodes packaged in a T-1¾ outline with a red non-diffused lens, which provides excellent on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

Maximum Ratings at T_A=25°C

Power Dissipation 120mW
(derate linearly from 50°C @ 1.6mW/°C)
Average Forward Current 20mA
Peak Transient Forward Current . . . . . 1 Amp
(1 μsec pulse width, 300 pps)
Peak Operating Forward Current 60mA
(0.5 msec pulse width)
Operating and Storage
Temperature Range . . . . . -55°C to +100°C
Lead Soldering Temperature . . . . . 230°C for 7 sec.
(1/16 inch below package base)

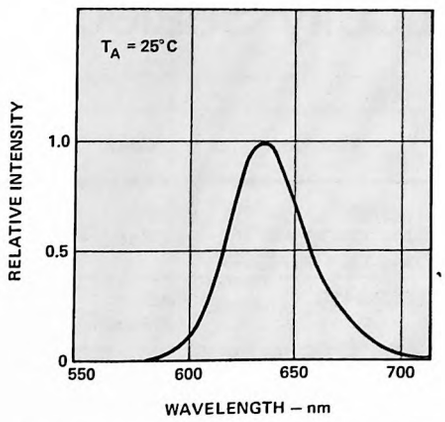


Figure 1. Relative Intensity versus Wavelength.

Electrical Characteristics at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_v	Luminous Intensity	4650 4655 4657 4658	1.0 3.0 9.0 15.0	2.0 4.0 12.0 24.0		mcd	I_F = 10mA (Figs. 4,5)
$\Theta_{1/2}$	Total Angle Between Half Luminous Intensity Points	4650 4655 4657 4658		90 90 35 35		Deg.	I_F = 10mA (Fig. 3)
λ_{pk}	Peak Wavelength			635		nm	Measurement at Peak (Fig. 1)
λ_d	Dominant Wavelength			626		nm	See Note 1 (Fig. 1)
τ_s	Speed of Response			90		ns	
C	Capacitance			16		pF	V_F = 0, f = 1 MHz
θ_{JC}	Thermal Resistance			135		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage			2.2	3.0	V	I_F = 10mA (Fig. 2)
BV_R	Reverse Breakdown Voltage		5.0			V	I_R = 100μA
η_v	Luminous Efficacy			135		lumens/watt	See Note 2

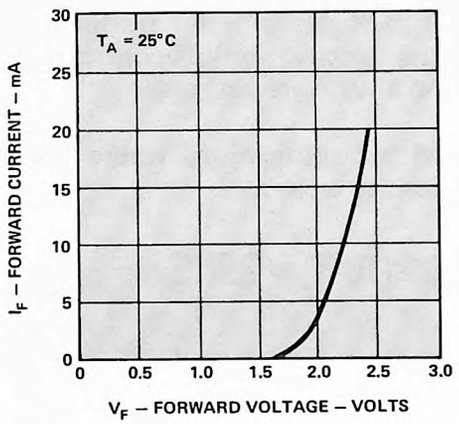


Figure 2. Forward Current versus Forward Voltage Characteristic.

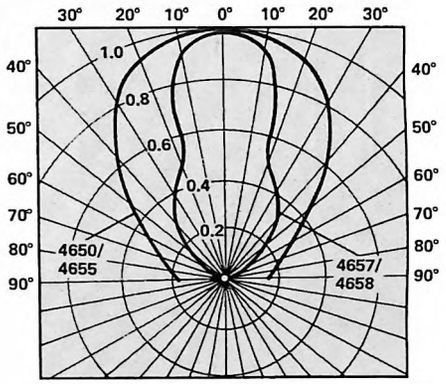


Figure 3. Relative Luminous Intensity versus Angular Displacement.

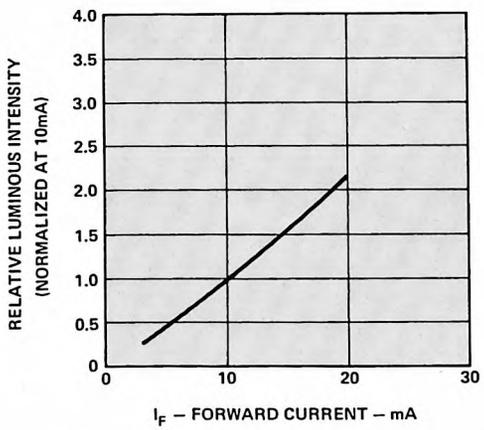


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

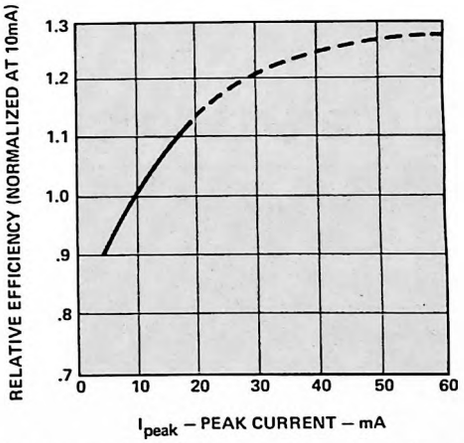


Figure 5. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

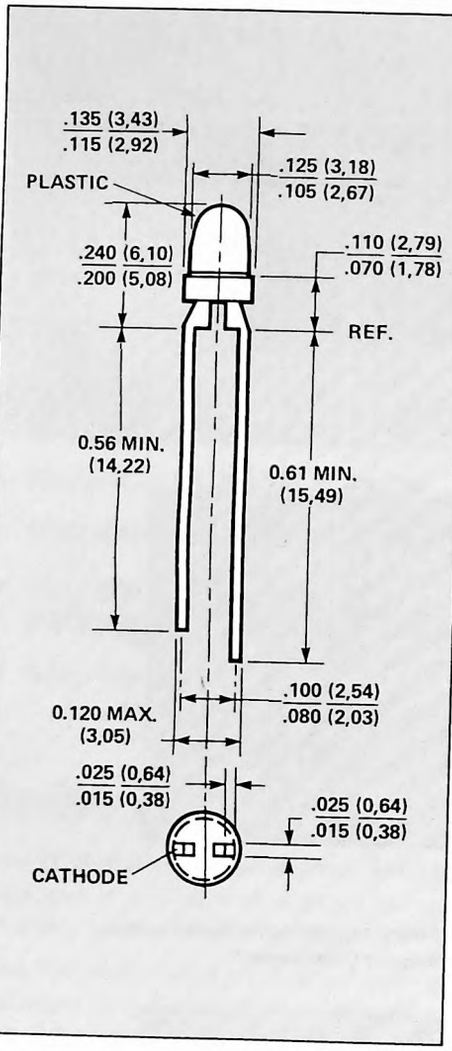
NOTES: 1. Dominant Wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which is perceived by the eye. 2. Radiant Intensity (I_e) in watts/steradian may be found from the equation: $I_e = I_v/\eta_v$ where I_v is the luminous intensity in candella and η_v is the luminous efficacy in lumens/watt.

HEWLETT hp PACKARD
COMPONENTS

HIGH EFFICIENCY RED SOLID STATE LAMPS (Mini-LED)

5082-4684 SERIES

TENTATIVE DATA MAY 1974



Features

- HIGH INTENSITY – 2.5 mcd TYPICAL @ I_F = 10mA
- WIDE VIEWING ANGLE – GREATER THAN 180°
- NON-SATURATING LIGHT OUTPUT
- SMALL SIZE T-1 DIAMETER (0.125")
- IC COMPATIBLE
- RELIABLE AND RUGGED

Description

The 5082-4684 is a Gallium Arsenide Phosphide High Efficiency Red Light Emitting Diode packaged in a T-1 outline with a red diffused lens, which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4684 is designed for applications where space is at a premium, such as in high density arrays.

Maximum Ratings at T_A=25°C

Power Dissipation 120mW
(Derate linearly from 50°C at 1.6mW/°C)
DC Forward Current 20mA
Peak Forward Current ..... 1 Amp
(1μsec pulse width, 300 pps)
Operating and Storage Temperature Range ... –55°C to +100°C
Lead Soldering Temperature ..... 230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4684			Units	Test Conditions
		Min.	Typ.	Max.		
I	Luminous Intensity	1.0	2.5		mcd	I_F= 10mA
λ_{pk}	Wavelength		635		nm	Measurement at Peak
τ_s	Speed of Response		90		ns	
C	Capacitance		20		pF	V_F = 0, f = 1MHz
θ_{JC}	Thermal Resistance		95		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage		2.2	3.0	V	I_F= 10mA
BV_R	Reverse Breakdown Voltage	5			V	I_R= 100μA

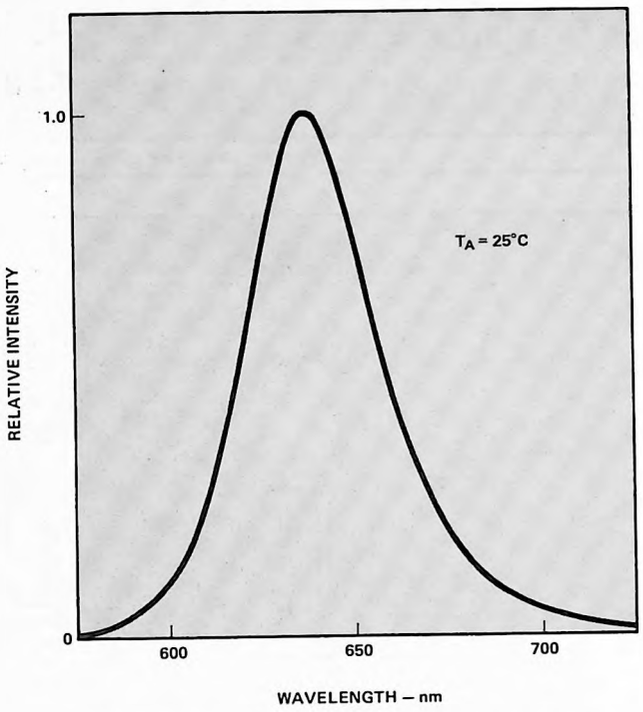


Figure 1. Relative Intensity versus Wavelength.

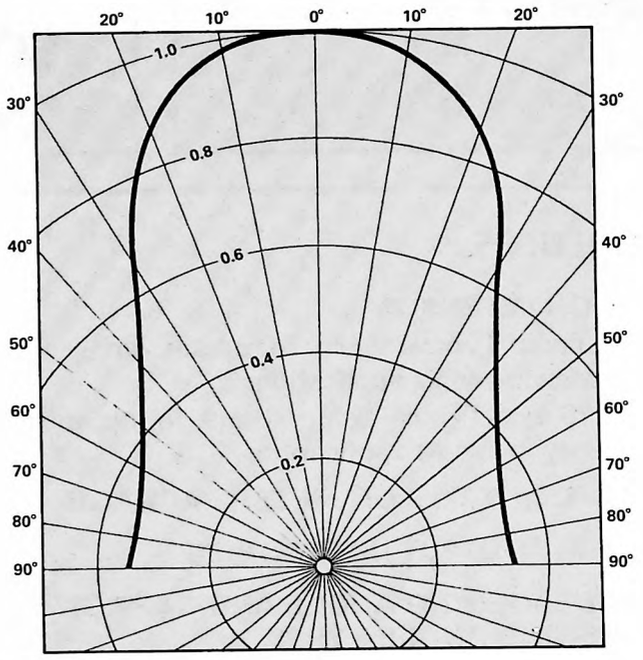


Figure 2. Relative Luminous Intensity versus Angular Displacement.

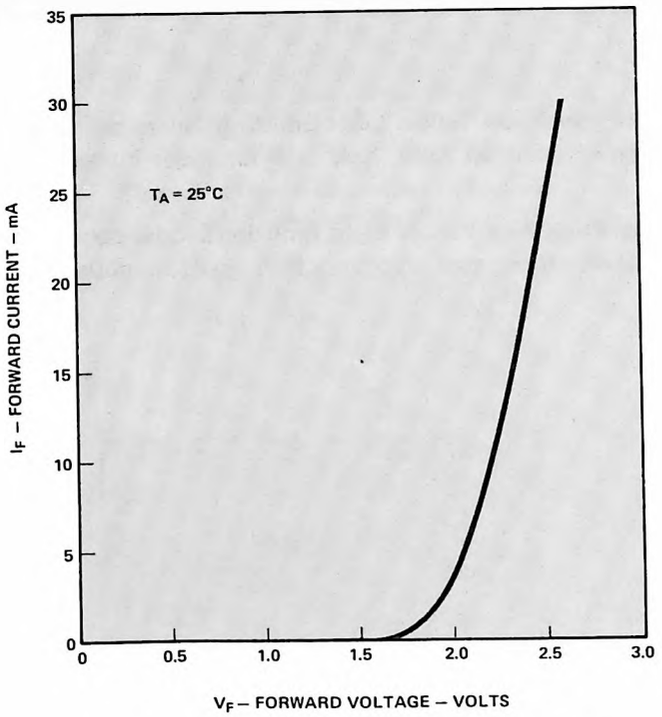


Figure 3. Forward Current versus Forward Voltage Characteristic.

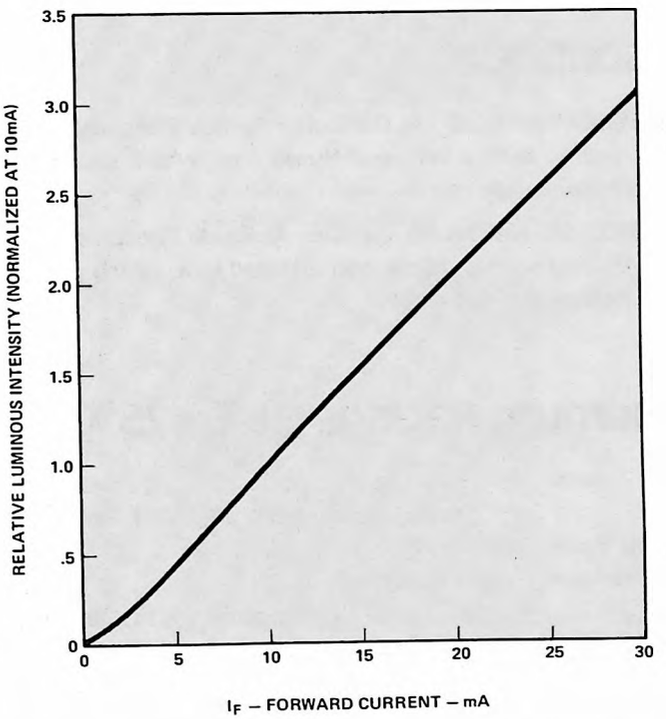


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

HEWLETT hp PACKARD

COMPONENTS

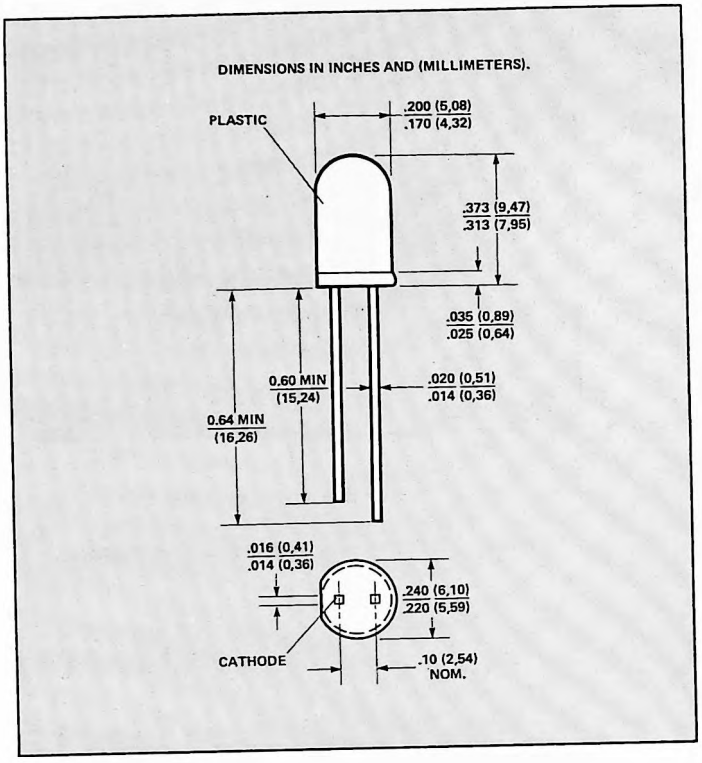
YELLOW SOLID STATE LAMPS

5082-4550
5082-4555
5082-4557
5082-4558

TENATIVE DATA NOVEMBER 1974

Features

- HIGH INTENSITY
  - 3 mcd Typical @ I_F = 10mA for wide-viewing angle applications.
  - 16 mcd Typical @ I_F = 10mA for narrow-viewing angle applications.
- POPULAR T-1¾ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- WIDE VIEWING ANGLE AND NARROW VIEWING ANGLE TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED



Description

The 5082-4550/4555 are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a T-1¾ outline with a yellow diffused lens, which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4557/4558 are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a T-1¾ outline with a yellow non-diffused lens, which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

Maximum Ratings at T_A=25°C

Power Dissipation 120mW
(derate linearly from 50°C @ 1.6mW/°C)
Average Forward Current 20mA
Peak Transient Forward Current . . . . . 1 Amp
(1 μsec pulse width, 300 pps)
Peak Operating Forward Current 60mA
(0.5 msec pulse width)

Operating and Storage
Temperature Range . . . . . -55°C to +100°C
Lead Soldering Temperature . . . . . 230°C for 7 sec.
(1/16 inch below package base)

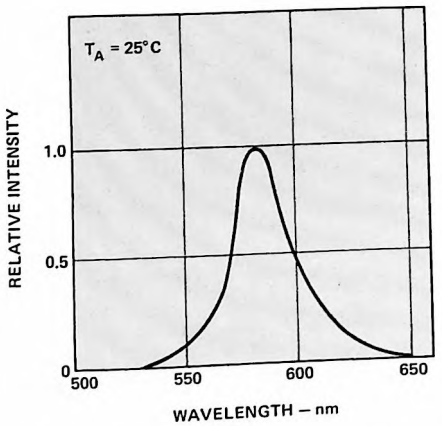


Figure 1. Relative Intensity versus Wavelength.

Electrical Characteristics at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_v	Luminous Intensity	4550 4555 4557 4558	1.0 2.2 6.0 12.0	1.8 3.0 9.0 16.0		mcd	I_F = 10mA (Figs. 4,5)
$\Theta_{1/2}$	Total Angle Between Half Luminous Intensity Points	4550 4555 4557 4558		90 90 35 35		Deg.	I_F = 10mA (Fig. 3)
λ_{pk}	Peak Wavelength			583		nm	Measurement at Peak (Fig. 1)
λ_d	Dominant Wavelength			585		nm	See Note 1 (Fig. 1)
τ_s	Speed of Response			90		ns	
C	Capacitance			18		pF	V_F = 0, f = 1 MHz
θ_{JC}	Thermal Resistance			135		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage			2.2	3.0	V	I_F = 10mA (Fig. 2)
BV_R	Reverse Breakdown Voltage		5.0			V	I_R = 100μA
η_v	Luminous Efficacy			460		lumens/watt	See Note 2

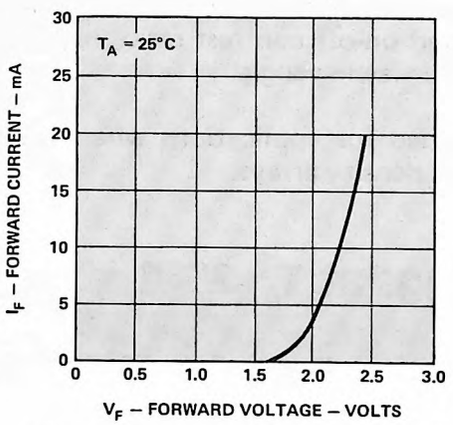


Figure 2. Forward Current versus Forward Voltage Characteristic.

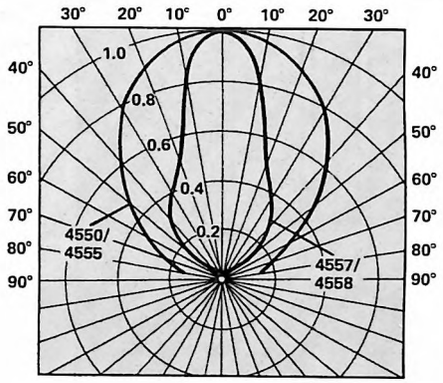


Figure 3. Relative Luminous Intensity versus Angular Displacement.

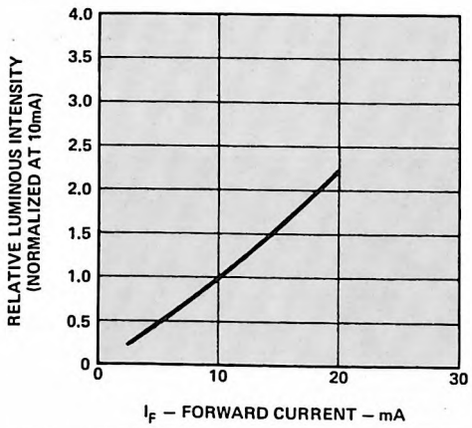


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

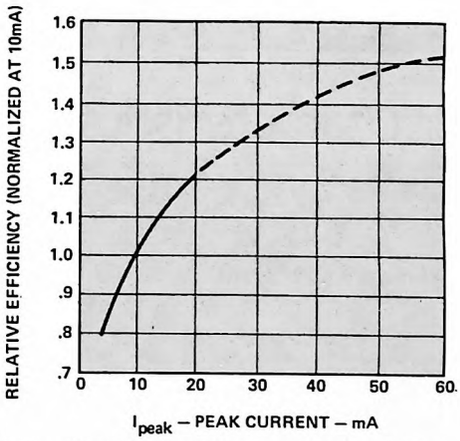


Figure 5. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

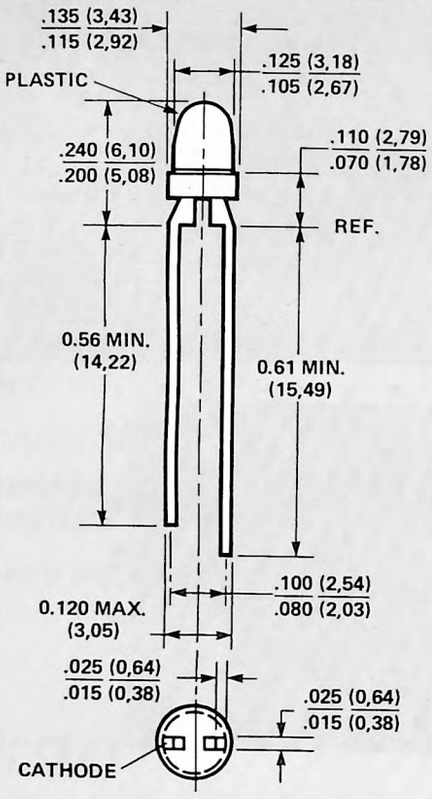
NOTES: 1. Dominant Wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which is perceived by the eye. 2. Radiant Intensity (I_e) in watts/steradian may be found from the equation: $I_e = I_v/\eta_v$ where I_v is the luminous intensity in candella and η_v is the luminous efficacy in lumens/watt.

HEWLETT hp PACKARD
COMPONENTS

YELLOW SOLID STATE LAMPS (Mini-LED)

5082-4584

TENTATIVE DATA MAY 1974



Features

- HIGH INTENSITY – 2.5 mcd TYPICAL @ I_F = 10mA
- WIDE VIEWING ANGLE – GREATER THAN 180°
- SMALL SIZE T-1 DIAMETER (0.125")
- IC COMPATIBLE
- RELIABLE AND RUGGED

Description

The 5082-4584 is a Gallium Arsenide Phosphide Yellow Light Emitting Diode packaged in a T-1 outline with a yellow diffused lens, which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4584 is designed for applications where space is at a premium, such as in high density arrays.

Maximum Ratings at T_A=25°C

Power Dissipation 120mW
(Derate linearly from 50°C at 1.6mW/°C)
DC Forward Current 20mA
Peak Forward Current .....1 Amp
(1μsec pulse width, 300 pps)
Operating and Storage Temperature Range ... –55°C to +100°C
Lead Soldering Temperature ..... 230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4584			Units	Test Conditions
		Min.	Typ.	Max.		
I	Luminous Intensity	1.0	2.5		mcd	I_F= 10mA
λ_{pk}	Wavelength		583		nm	Measurement at Peak
τ_s	Speed of Response		90		ns	
C	Capacitance		15		pF	V_F = 0, f = 1MHz
θ_{JC}	Thermal Resistance		95		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage		2.2	3.0	V	I_F= 10mA
BV_R	Reverse Breakdown Voltage	5			V	I_R= 100μA

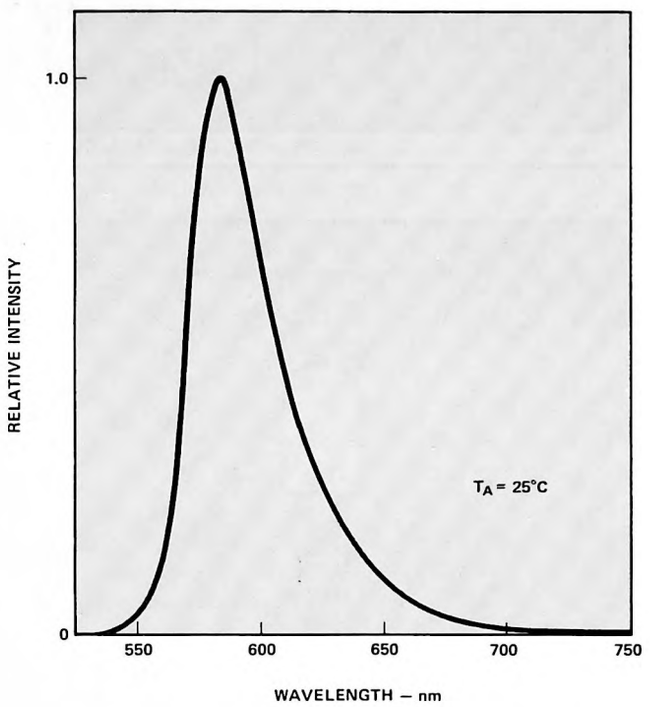


Figure 1. Relative Intensity versus Wavelength.

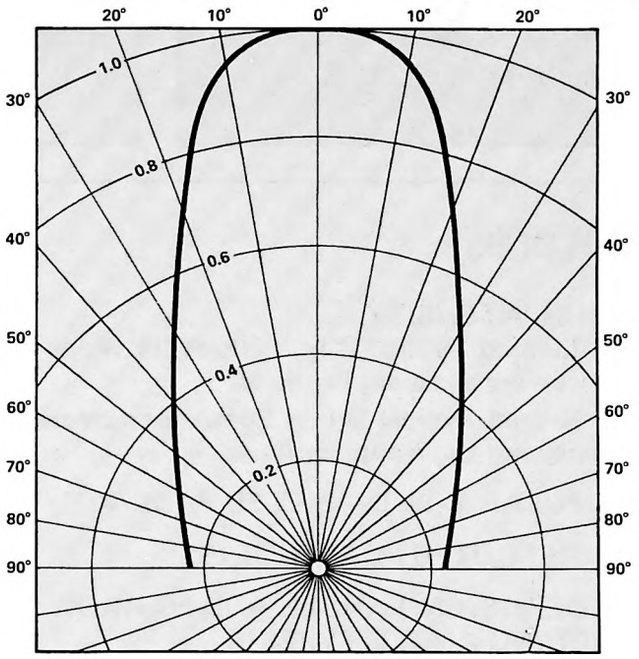


Figure 2. Relative Luminous Intensity versus Angular Displacement.

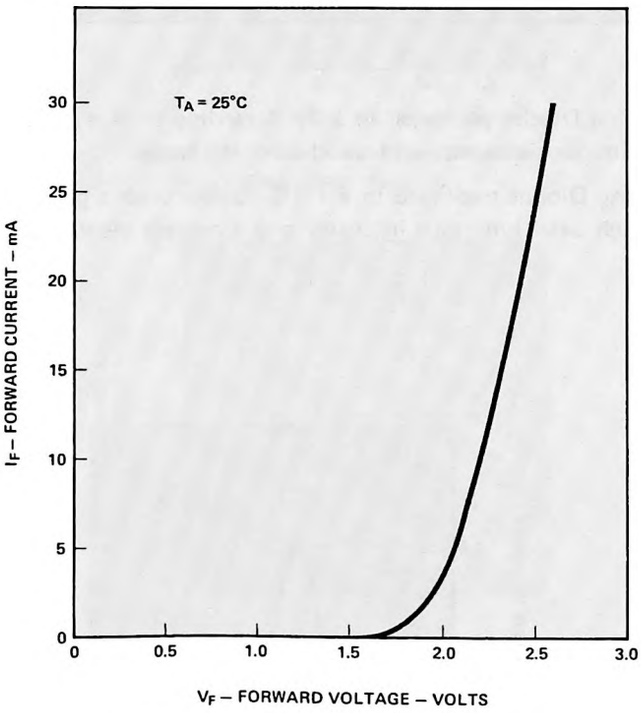


Figure 3. Forward Current versus Forward Voltage Characteristic.

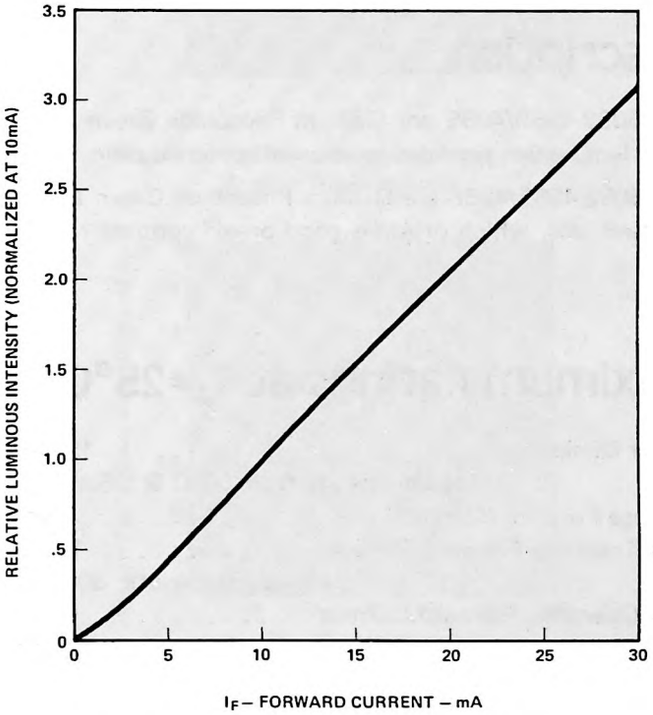


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

HEWLETT hp PACKARD
COMPONENTS

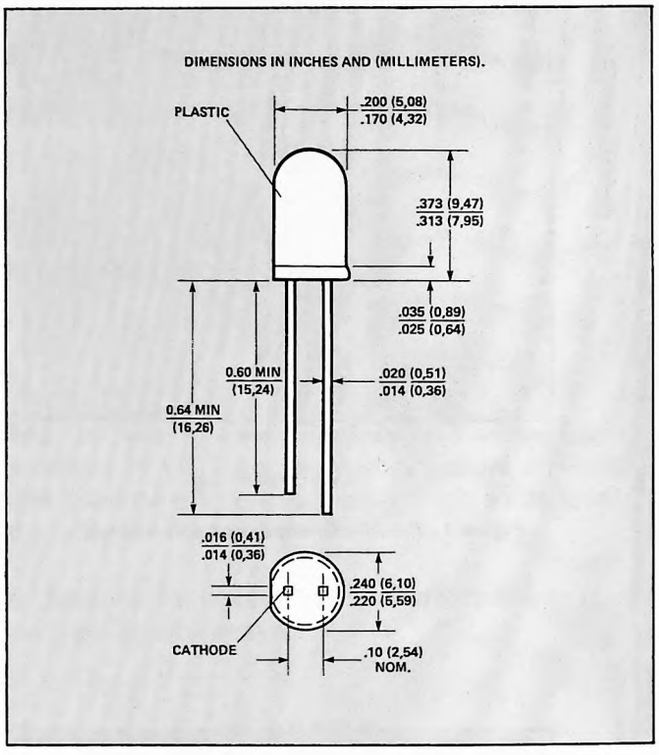
GREEN SOLID STATE LAMPS

5082-4950
5082-4955
5082-4957
5082-4958

TENTATIVE DATA NOVEMBER 1974

Features

- HIGH INTENSITY
  - 3.0 mcd Typical @ I_F = 20mA for wide-viewing angle applications.
  - 16 mcd Typical @ I_F = 20mA for narrow-viewing angle applications.
- POPULAR T-1¾ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- WIDE VIEWING ANGLE AND NARROW VIEWING ANGLE TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED



Description

The 5082-4950/4955 are Gallium Phosphide Green Light Emitting Diodes packaged in a T-1¾ outline with a green diffused lens, which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4957/4958 are Gallium Phosphide Green Light Emitting Diodes packaged in a T-1¾ outline with a green non-diffused lens, which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

Maximum Ratings at T_A=25°C

Power Dissipation 120mW
(derate linearly from 50°C @ 1.6mW/°C)
Average Forward Current 30mA
Peak Transient Forward Current . . . . . 1 Amp
(1 μsec pulse width, 300 pps)
Peak Operating Forward Current 60mA
(0.5 msec pulse width)
Operating and Storage
Temperature Range . . . . . -55°C to +100°C
Lead Soldering Temperature . . . . . 230°C for 7 sec.
(1/16 inch below package base)

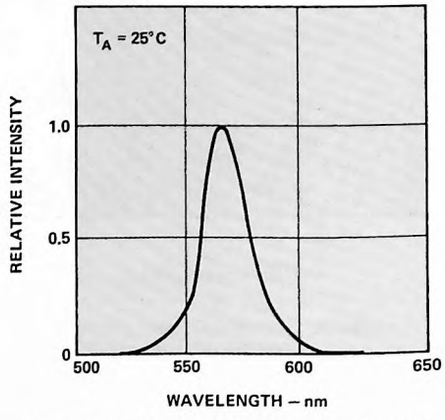


Figure 1. Relative Intensity versus Wavelength.

Electrical Characteristics at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_v	Luminous Intensity	4950 4955 4957 4958	1.0 2.2 6.0 12.0	1.8 3.0 9.0 16.0		mcd	I_F = 20mA (Figs. 4,5)
$\Theta_{1/2}$	Total Angle Between Half Luminous Intensity Points	4950 4955 4957 4958		90 90 30 30		Deg.	I_F = 20mA (Fig. 3)
λ_{pk}	Peak Wavelength			565		nm	Measurement at Peak (Fig. 1)
λ_d	Dominant Wavelength			572		nm	See Note 1 (Fig. 1)
τ_s	Speed of Response			200		ns	
C	Capacitance			18		pF	V_F = 0, f = 1 MHz
θ_{JC}	Thermal Resistance			145		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage			2.4	3.0	V	I_F = 20mA (Fig. 2)
BV_R	Reverse Breakdown Voltage		5.0			V	I_R = 100μA
η_v	Luminous Efficacy			630		lumens/watt	See Note 2

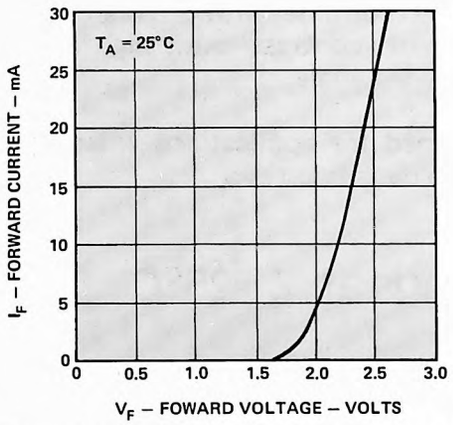


Figure 2. Forward Current versus Forward Voltage Characteristic.

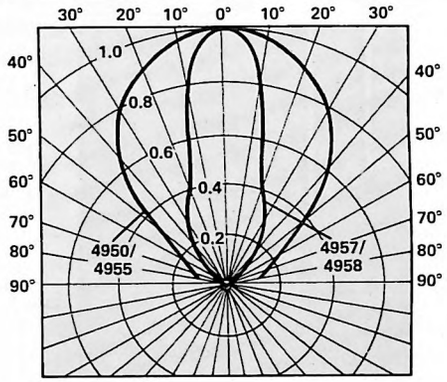


Figure 3. Relative Luminous Intensity versus Angular Displacement.

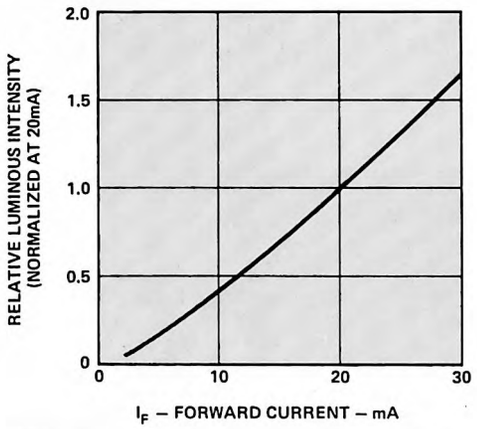


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

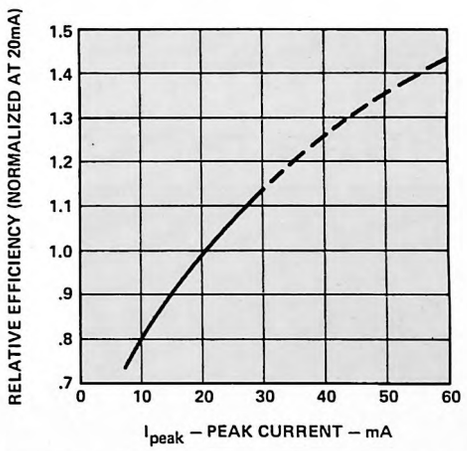


Figure 5. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

NOTES: 1. Dominant Wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which is perceived by the eye. 2. Radiant Intensity (I_e) in watts/steradian may be found from the equation: $I_e = I_v/\eta_v$ where I_v is the luminous intensity in candella and η_v is the luminous efficacy in lumens/watt.

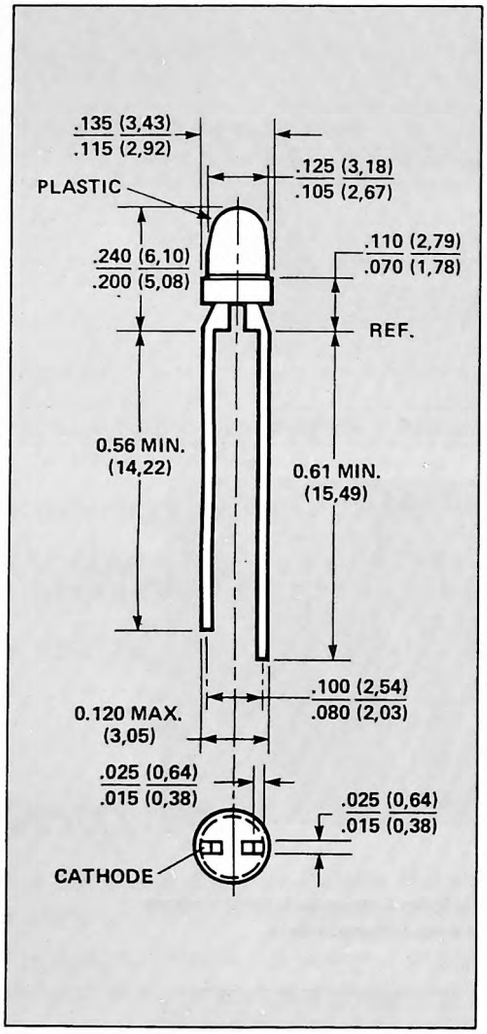
HEWLETT hp PACKARD

COMPONENTS

GREEN SOLID STATE LAMPS (Mini-LED)

5082-4984

TENTATIVE DATA MAY 1974



Features

- HIGH INTENSITY – 2.0 mcd TYPICAL @ I_F = 20 mA
- WIDE VIEWING ANGLE – GREATER THAN 180°
- SMALL SIZE T-1 DIAMETER (0.125")
- IC COMPATIBLE
- RELIABLE AND RUGGED

Description

The 5082-4984 is a Gallium Phosphide Green Light Emitting Diode packaged in a T-1 outline with a green diffused lens, which provides good on-off contrast ratio, high axial luminous intensity, and a wide viewing angle.

The 5082-4984 is designed for applications where space is at a premium, such as in high density arrays.

Maximum Ratings at T_A=25°C

Power Dissipation ..... 120 mW
(Derate linearly from 50°C at 1.6 mW/°C)
DC Forward Current ..... 30 mA
Peak Forward Current ..... 1 Amp
(1 μsec pulse width, 300 pps)
Operating and Storage Temperature Range ... –55°C to +100°C
Lead Soldering Temperature ..... 230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4984			Units	Test Conditions
		Min.	Typ.	Max.		
I	Luminous Intensity	0.8	2.0		mcd	I_F = 20 mA
λ_{pk}	Wavelength		565		nm	Measurement at Peak
τ_s	Speed of Response		200		ns	
C	Capacitance		8		pF	V_F = 0, f = 1 MHz
θ_{JC}	Thermal Resistance		95		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage		2.4	3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5			V	I_R = 100 μA

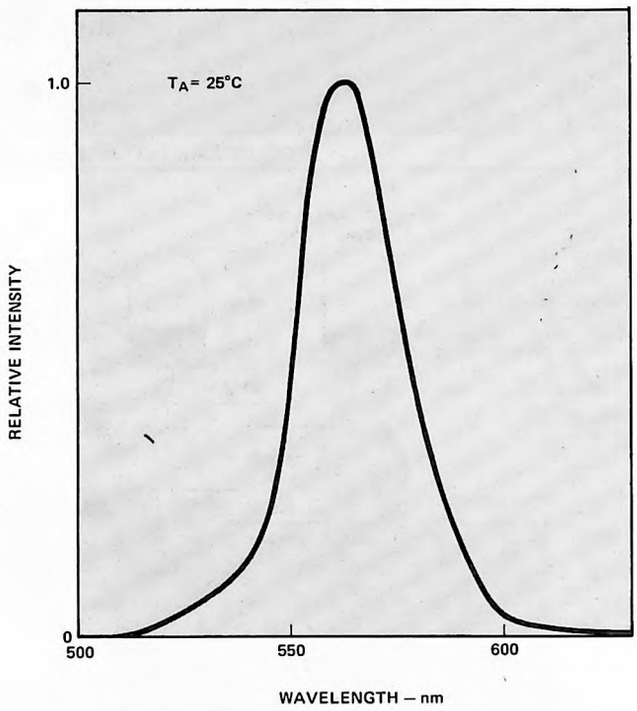


Figure 1. Relative Intensity versus Wavelength.

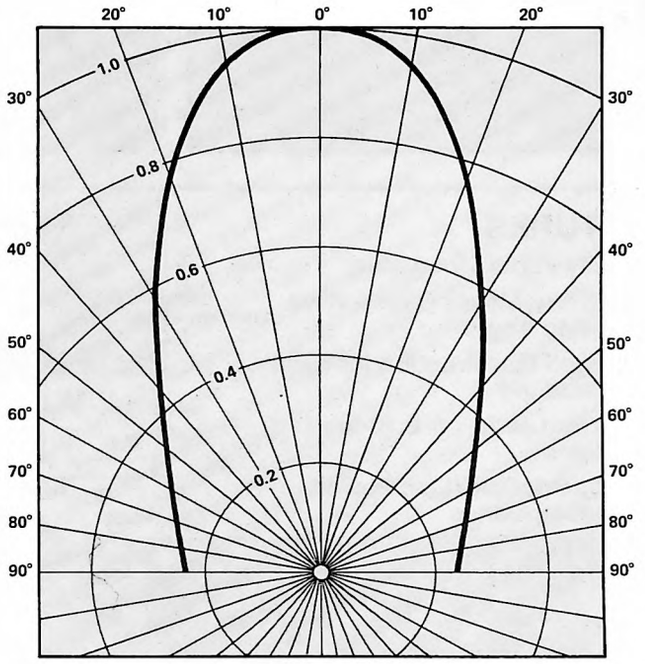


Figure 2. Relative Luminous Intensity versus Angular Displacement.

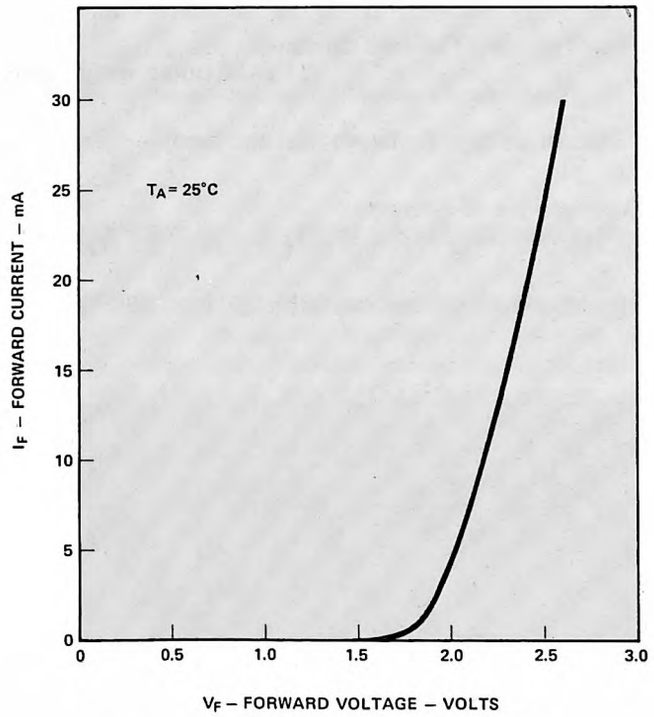


Figure 3. Forward Current versus Forward Voltage Characteristic.

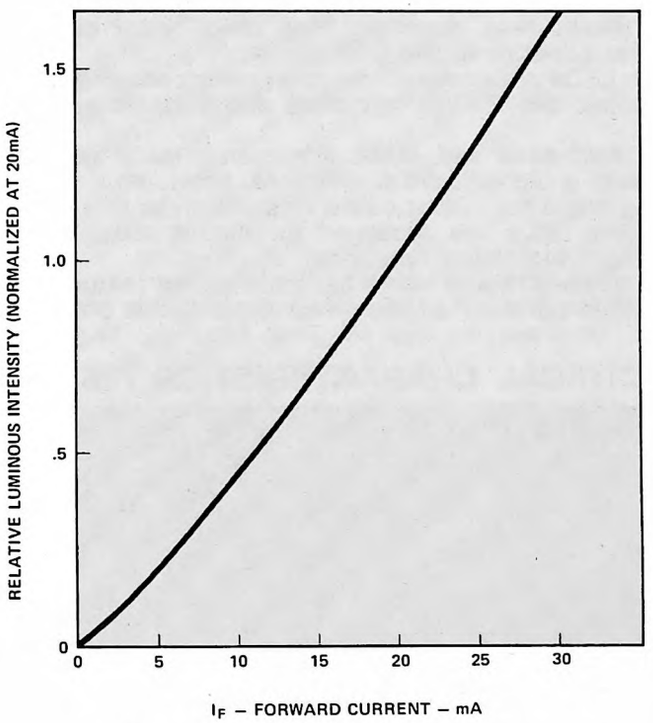


Figure 4. Relative Luminous Intensity versus Forward Current (I_F).

HEWLETT hp PACKARD

COMPONENTS

SOLID STATE LAMPS

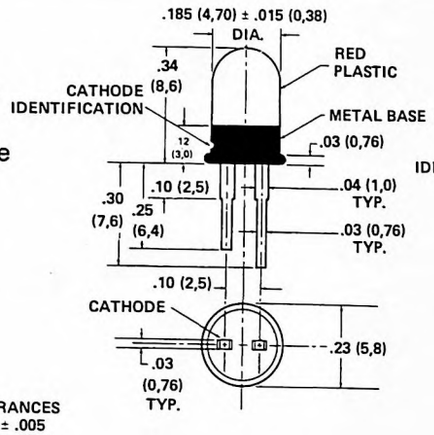
5082-4403
5082-4415
5082-4440
5082-4444

TECHNICAL DATA JANUARY 1975

FEATURES

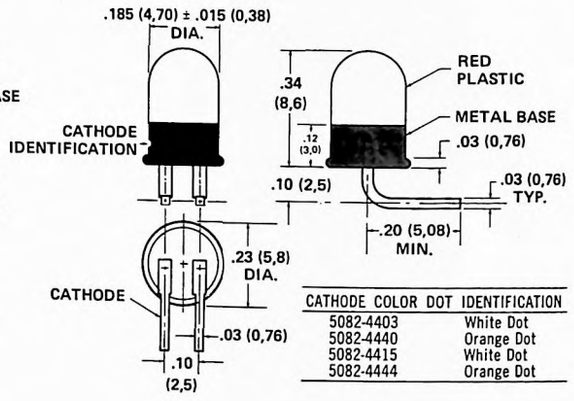
- Easily Panel Mountable
- High Brightness Over a Wide Viewing Angle
- Rugged Construction for Ease of Handling
- Sturdy Leads on 0.10-inch Centers
- IC Compatible/Low Power Consumption
- Long Life

ACTUAL SIZE



TOLERANCES
xxx ± .005
xx ± .02

FOR PANEL MOUNTING
5082-4403
5082-4440



CATHODE COLOR DOT IDENTIFICATION	
5082-4403	White Dot
5082-4440	Orange Dot
5082-4415	White Dot
5082-4444	Orange Dot

FOR RIGHT ANGLE
PC BOARD MOUNTING
5082-4415
5082-4444

DESCRIPTION

The **5082-4403, -4415, -4440 and -4444** are plastic encapsulated Gallium Arsenide Phosphide Light Emitting Diodes. They radiate light in the 655 nanometer (red light) region.

The **5082-4403 and -4415** are LEDs with a red diffused plastic lens, providing high visibility for circuit board or panel mounting with a clip.

Both LEDs are designed for low power consumption, thus applicable for use in mobile and portable equipment.

The **5082-4440 and -4444** are economically priced LEDs with a red diffused plastic lens, providing a wide viewing angle for circuit board or panel mounting with clip. Both LEDs are designed for circuit status and other light indicating functions.

The **5082-4415 and -4444** have the added feature of a 90° lead bend for edge mounting on circuit boards.

MAXIMUM RATINGS (25°C)

DC Power Dissipation ..... 100 mW
(Derate linearly from 50°C at 1.6mW/°C.)

DC Forward Current ..... 50 mA

Peak Transient Forward Current ..... 1 Amp
(1 μsec pulse width, 300 pps)

Isolation Voltage (between lead and base) ..... 300 V

Operating and Storage
Temperature Range ..... −55°C to +100°C

Lead Soldering Temperature ..... 230°C for 7 sec

ELECTRICAL CHARACTERISTICS (25°C)

Symbol	Parameters	5082-4403 5082-4415			5082-4440 5082-4444			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I	Luminous Intensity	0.8	1.2		0.3	0.7		mcd	$I_F = 20$ mA
λ_{pk}	Wavelength	640	655	670	640	655	670	nm	Measurement at Peak
τ_s	Speed of Response		15			15		ns	
c	Capacitance		200			200		pF	$V_F = 0$, f = 1 MHz
θ_{JC}	Thermal Resistance		270			270		°C/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0		1.6	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3	10		3	10		V	$I_R = 10$ μA

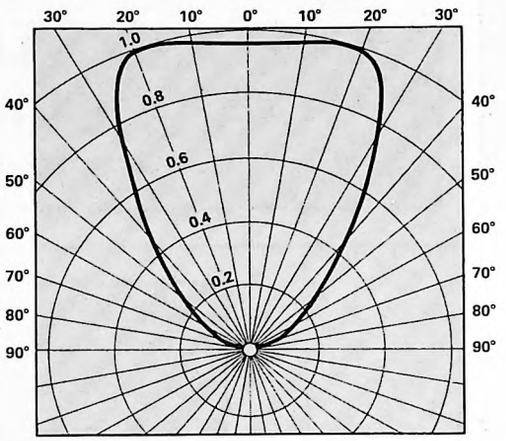


Figure 1. Relative Luminous Intensity vs. Angular Displacement.

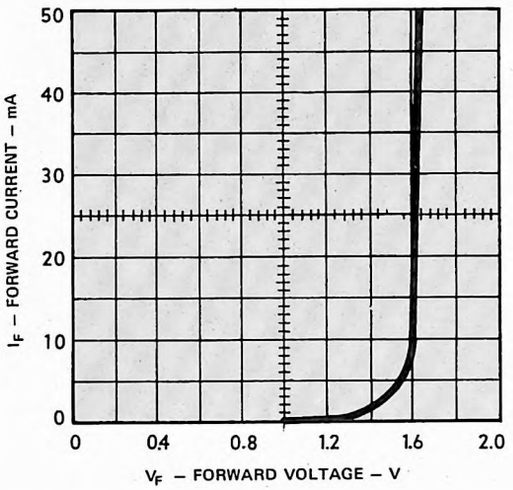


Figure 2. Forward Current – Voltage Characteristics.

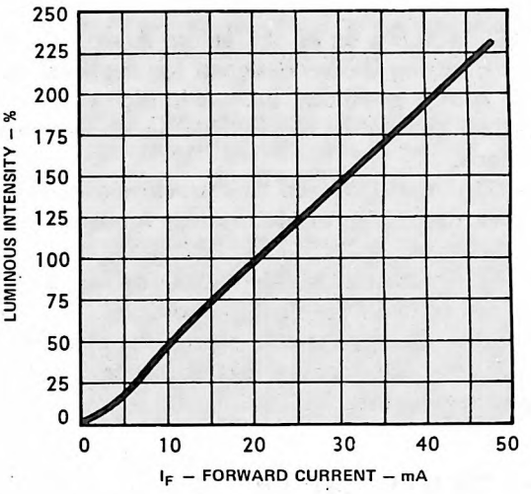


Figure 3. Brightness vs. Forward Current.

PC Board Mounting Information

The 5082-4403 and 5082-4440 are intended to be versatile in their mounting capability, as shown in the sketches following. Various printed circuit board mounting means are shown in Figures 4, 5, and 6. The enlarged lead section provides a controlled spacing for perpendicular mounting shown in Figure 4.

For right angle mounting as shown in Figure 6, order either a 5082-4415 or 5082-4444. The leads are bent at 90°, ready for insertion.

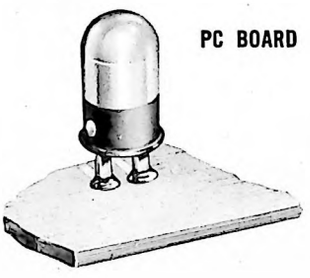


Figure 4. 5082-4403, -4440

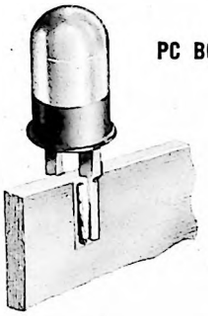


Figure 5. 5082-4403, -4440

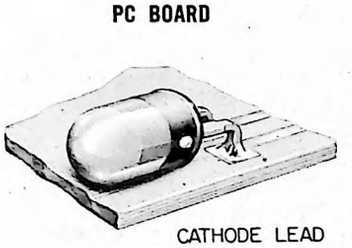


Figure 6. 5082-4415, -4444

HEWLETT hp PACKARD
COMPONENTS

SOLID STATE LAMPS (Mini-LED)

5082-4480 SERIES

TECHNICAL DATA JAN 73

Features

- HIGH INTENSITY – 0.8mcd TYPICAL
- WIDE VIEWING ANGLE
- SMALL SIZE T-1 DIAMETER (0.125")
- IC COMPATIBLE
- RELIABLE AND RUGGED

Description

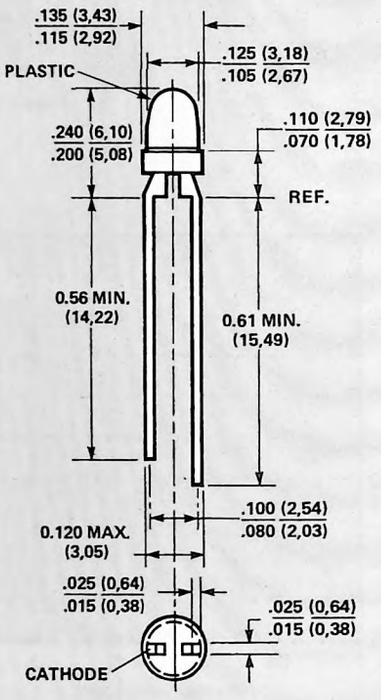
The 5082-4480 is a series of Gallium Arsenide Phosphide Light Emitting Diodes designed for applications where space is at a premium, such as in high density arrays.

The 5082-4480 series is available in three lens configurations.

5082-4480 – Red Diffused lens provides excellent on-off contrast ratio, high axial luminous intensity, and wide viewing angle.

5082-4483 – Same as 5082-4480, but Clear Diffused to mask red color in the "off" condition.

5082-4486 – Clear plastic lens provides a point source. Useful when illuminating external lens, annunciators, or photo-detectors.



PART NO.	LENS CONFIGURATION
5082-4480	Red Diffused
5082-4483	Clear Diffused
5082-4486	Clear Plastic

Maximum Ratings at T_A=25°C

DC Power Dissipation 100mW
(Derate linearly from 50°C at 1.6mW/°C)

DC Forward Current 50mA

Peak Forward Current . . . . . 1 Amp
(1 μsec pulse width, 300 pps)

Operating and Storage Temperature Range . . . . . –55°C to +100°C

Lead Soldering Temperature . . . . . 230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4480 5082-4483 5082-4486			Units	Test Conditions
		Min.	Typ.	Max.		
I	Luminous Intensity	0.3	0.8		mcd	I_F = 20mA
λ_{pk}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
C	Capacitance		200		pF	V_F = 0, f = 1MHz
θ_{JC}	Thermal Resistance		270		°C/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0	V	I_F = 20mA
BV_R	Reverse Breakdown Voltage	3	10		V	I_R = 10μA

Mounting Information

The 5082-4480 series is designed for flush PC board mounting. It is ideally suited for large area arrays.

The -4480 is mounted in 0.045" holes on either 0.090" or 0.100" centers.

The -4480 is easily laid out in large area X-Y addressable arrays, with the lamps on 0.125" (minimum) centers. Figure 1 illustrates a typical PC board layout for such an array. Note that it is preferable to mount the lamps with their leads aligned on the diagonal. Typical mounting dimensions are included in the sketch.

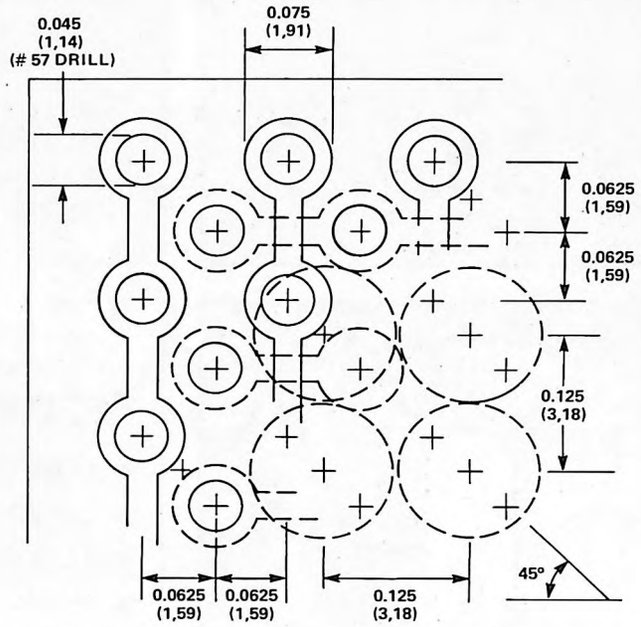
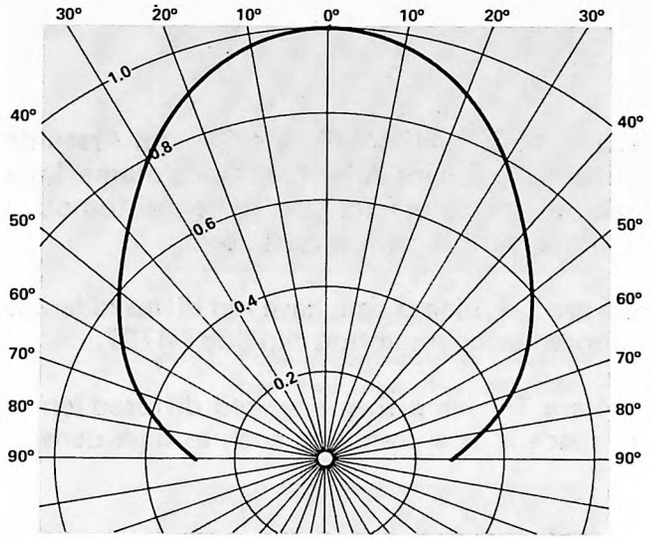
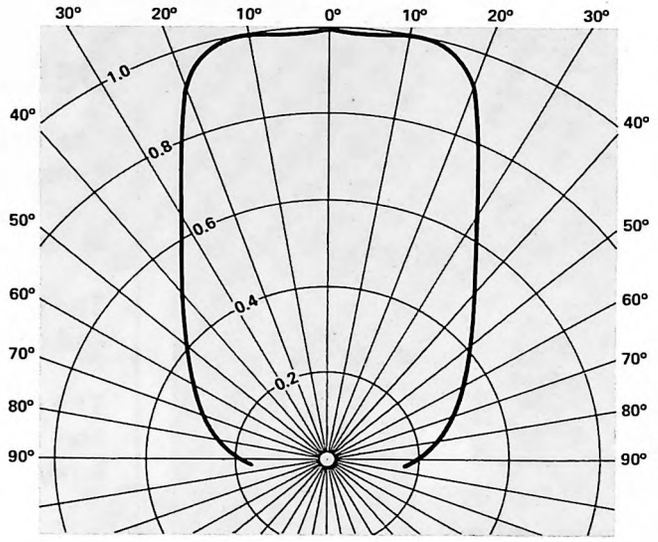


Figure 1. Typical PC board layout for an X-Y addressable array. LED's may be spaced as closely as 0.125" on centers.

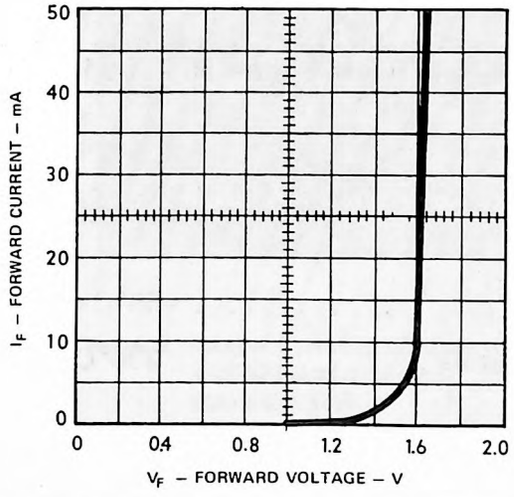
RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT 5082-4480 AND 5082-4483



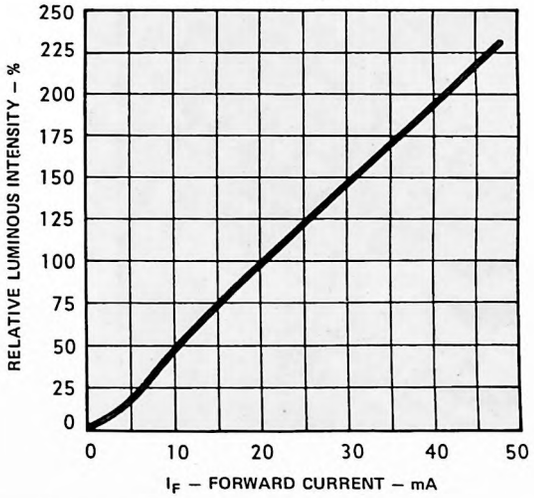
RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT 5082-4486



FORWARD CURRENT – VOLTAGE CHARACTERISTIC



LUMINOUS INTENSITY VS. FORWARD CURRENT



HEWLETT hp PACKARD

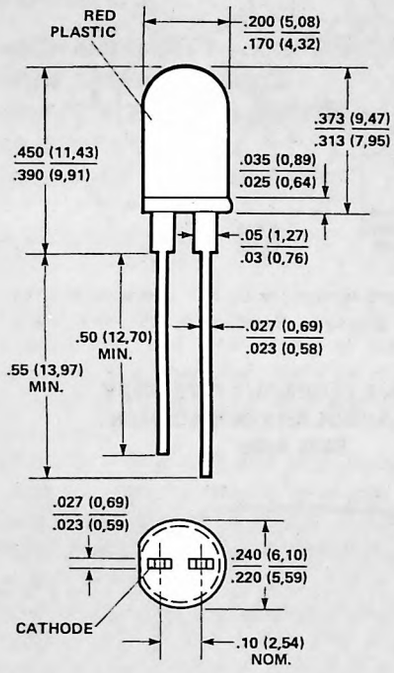
COMPONENTS

COMMERCIAL LIGHT EMITTING DIODES

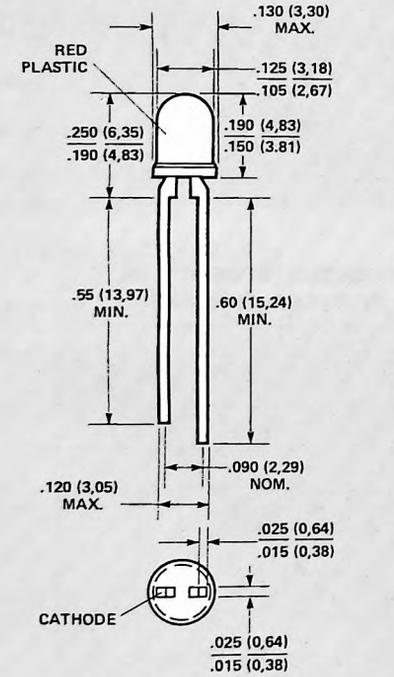
5082 - 4850
5082 - 4855
5082 - 4484
5082 - 4494

TECHNICAL DATA JUNE 1974

Dimensions in inches and (millimeters).



5082-4850/4855



5082-4484/4494

Features

- LOW COST – BROAD APPLICATION
- LONG LIFE – SOLID STATE RELIABILITY
- LOW POWER REQUIREMENTS – 20mA @ 1.6V
- HIGH LIGHT OUTPUT
  - 0.8 mcd TYPICAL FOR 5082-4850/4484
  - 1.4 mcd TYPICAL FOR 5082-4855/4494
- WIDE VIEWING ANGLE
- RED DIFFUSED LENS

Description

The 5082-4850/4855 and 5082-4484/4494 are Gallium Arsenide Phosphide Light Emitting Diodes intended for **High Volume/Low Cost** applications such as indicators for appliances, automobile instrument panels and many other commercial uses.

The 5082-4850/4855 are T-1¾ lamp size, have red diffused lenses and can be panel mounted using mounting clip 5082-4707.

The 5082-4484/4494 are T-1 lamp size, have red diffused lenses and are ideal where space is at a premium, such as high density arrays.

Maximum Ratings at T_A=25°C

Power Dissipation 100mW
(Derate linearly from 50°C at 1.6mW/°C)

DC Forward Current 50mA

Peak Forward Current 1Amp
(1μsec pulse width, 300pps)

Operating and Storage
Temperature Range ..... -55°C to +100°C

Lead Soldering Temperature ..... 230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4850			5082-4855			5082-4484			5082-4494			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Luminous Intensity		0.8		0.8	1.4			0.8		0.8	1.4		mcd	I_F = 20mA
λpk	Wavelength		655			655			655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10			10			10		ns	
C	Capacitance		100			100			100			100		pF	V_F = 0, f = 1MHz
V_F	Forward Voltage		1.6	2.0		1.6	2.0		1.6	2.0		1.6	2.0	V	I_F = 20mA
BV_R	Reverse Breakdown Voltage	3	10		3	10		3	10		3	10		V	I_R = 100μA

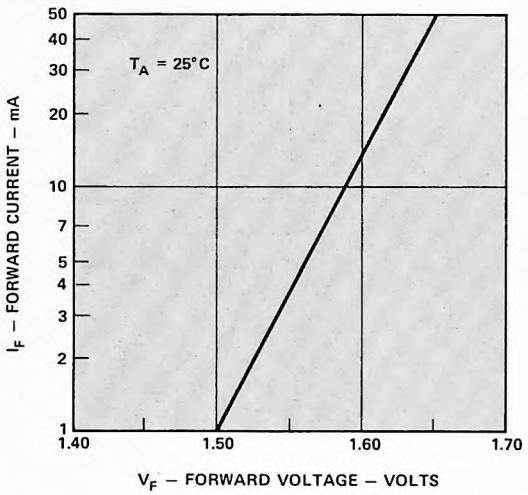


Figure 1. Forward Current Versus Forward Voltage Characteristic For 5082-4850/4855/4484/4494.

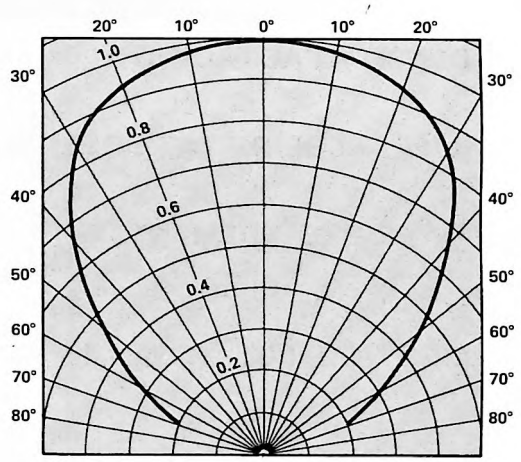


Figure 2. Relative Luminous Intensity Versus Angular Displacement For 5082-4850/4855.

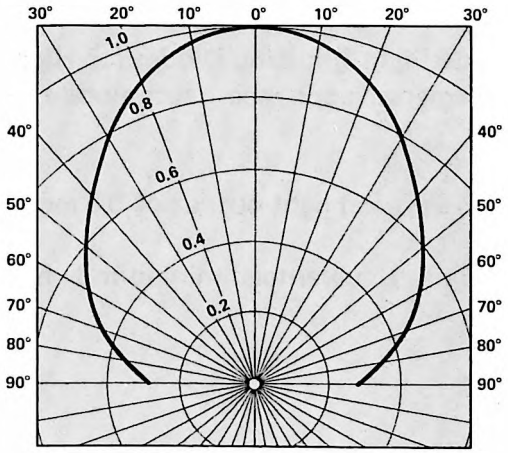


Figure 3. Relative Luminous Intensity Versus Angular Displacement For 5082-4484/4494.

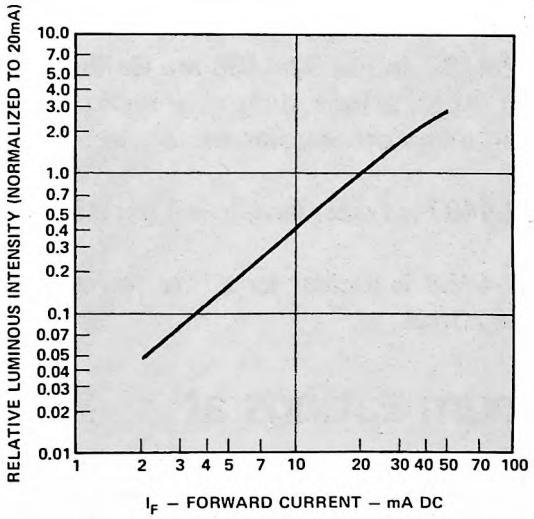


Figure 4. Relative Luminous Intensity Versus Forward Current For 5082-4850/4855/4484/4494.

HEWLETT hp PACKARD

COMPONENTS

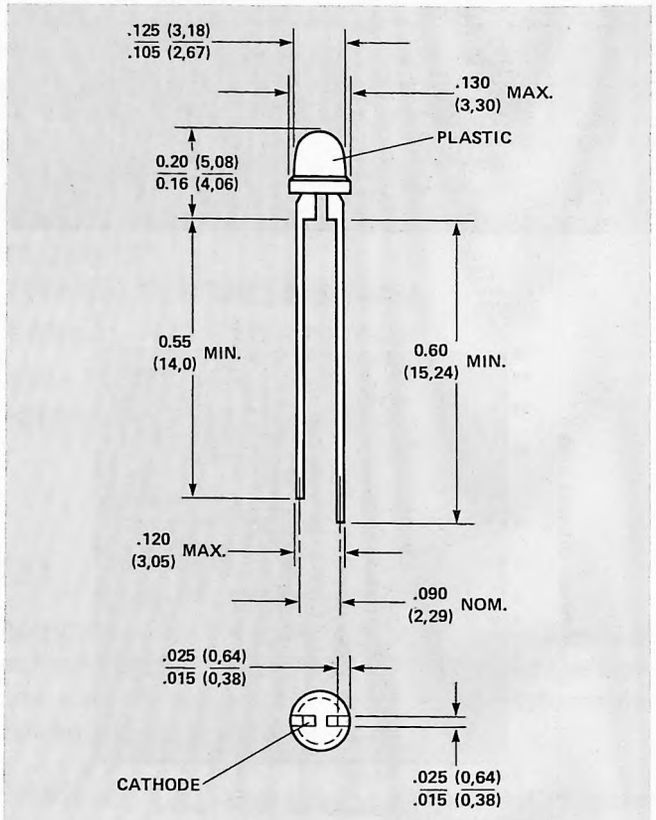
COMMERCIAL LIGHT EMITTING DIODES

5082-4487 5082-4488

TECHNICAL DATA SEPT. 1973

Features

- LOW COST – BROAD APPLICATION
- LOW PROFILE – 0.18" LENS HEIGHT TYPICAL
- HIGH DENSITY PACKAGING
- LONG LIFE – SOLID STATE RELIABILITY
- LOW POWER REQUIREMENTS – 20mA @ 1.6V
- HIGH LIGHT OUTPUT – 0.8mcd TYPICAL



5082-4487/4488

Description

The 5082-4487 and 5082-4488 are Gallium Arsenide Phosphide Light Emitting Diodes for High Volume/ Low Cost Applications such as indicators for calculators, cameras, appliances, automobile instrument panels, and many other commercial uses.

The 5082-4487 is a clear lens, low domed T-1 LED lamp, and has a typical light output of 0.8 mcd at 20 mA.

The 5082-4488 is a clear lens, low domed T-1 LED lamp, and has a guaranteed minimum light output of 0.3 mcd at 20 mA.

Maximum Ratings at T_A=25°C

DC Power Dissipation [Derate linearly from 50°C at 1.6 mW/°C]	100 mW
DC Forward Current	50 mW
Peak Forward Current [1 μsec pulse width, 300 pps]	1 Amp
Operating and Storage Temperature Range	–55°C to +100°C
Lead Soldering Temperature	230°C for 7 sec.

Electrical/Optical Characteristics at T_A=25°C

Symbol	Parameters	5082-4487			5082-4488			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Luminous Intensity		0.8		0.3	0.8		mcd	I_F = 20mA
λ_{pk}	Wavelength		655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10		ns	
C	Capacitance		100			100		pF	V_F = 0, f = 1MHz
V_F	Forward Voltage		1.6	2.0		1.6	2.0	V	I_F = 20mA
BV_R	Reverse Breakdown Voltage	3	10		3	10		V	I_R = 100μA

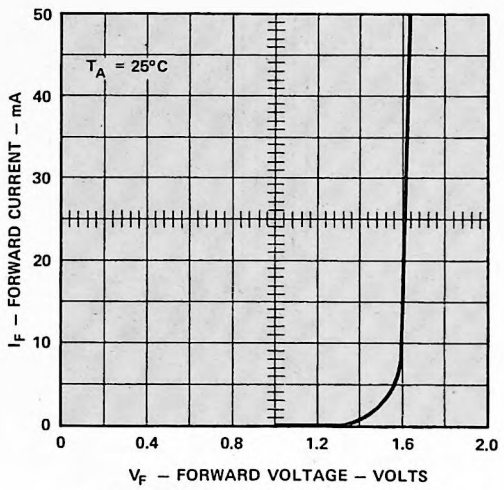


Figure 1. Typical Forward Current Versus Voltage Characteristic.

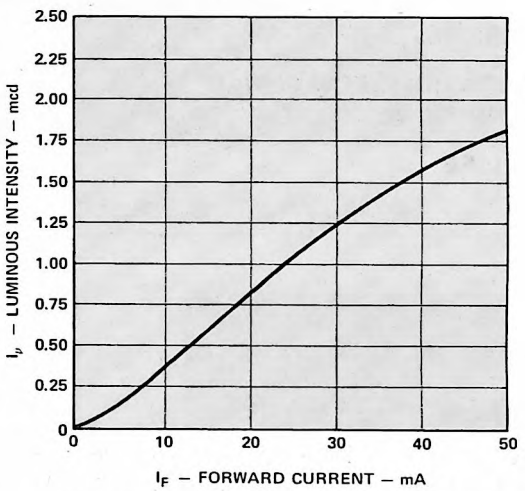


Figure 2. Typical Luminous Intensity Versus Forward Current.

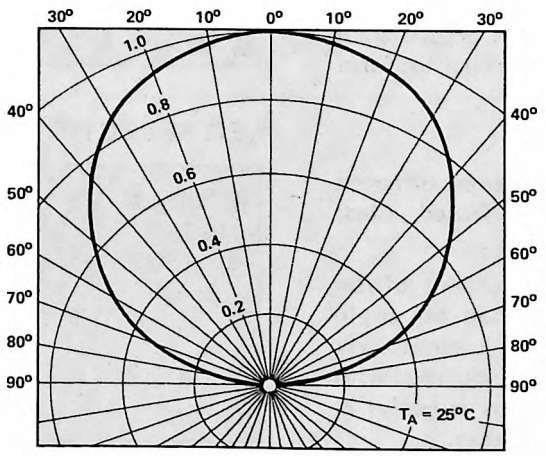


Figure 3. Typical Relative Luminous Intensity Versus Angular Displacement.

HEWLETT hp PACKARD

COMPONENTS

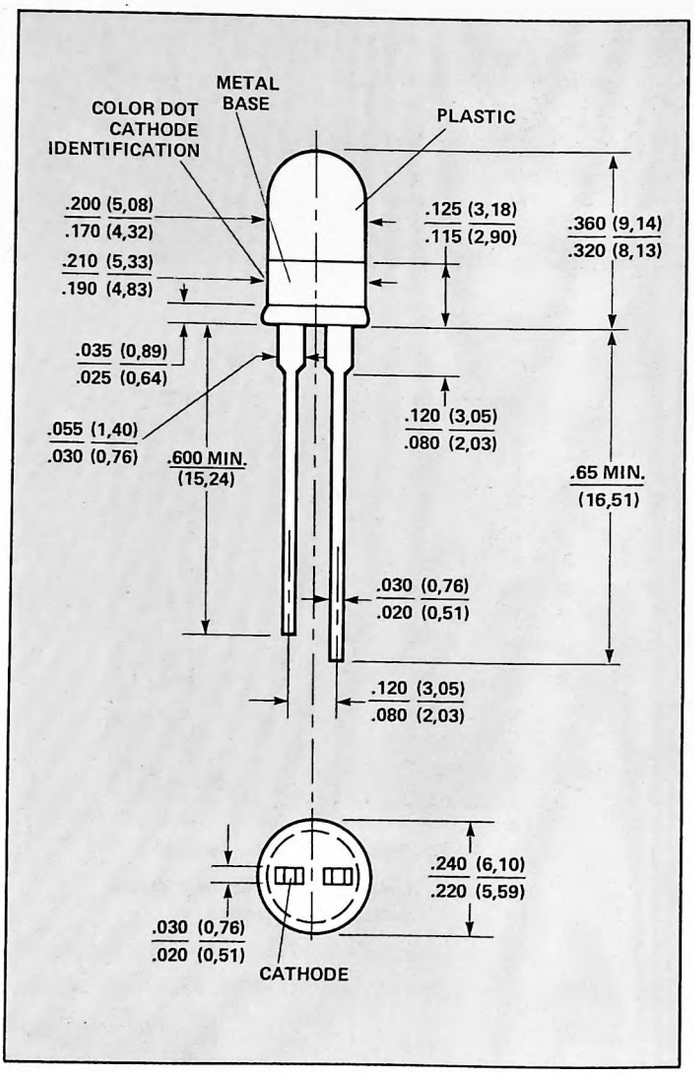
SOLID STATE LAMPS

5082-4880 SERIES

TECHNICAL DATA JANUARY 1975

FEATURES

- WIRE WRAPPABLE
- EASILY PANEL MOUNTABLE; CLIP AVAILABLE
- STURDY WELDABLE LEADS -- ON 0.10 INCH CENTERS
- HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE
- RUGGED CONSTRUCTION FOR EASE OF HANDLING
- IC COMPATIBLE/LOW POWER CONSUMPTION
- LONG LIFE



DESCRIPTION

Wire Wrappable

The 5082-4880 series is designed to be wire wrapped with the Gardner Denver Models 14R2, 14XL1, and 14XA2 or equivalent. The LED can be panel or PC mounted and the leads directly wire wrapped without the use of a socket.

Light Output Selection

The 5082-4880 series is available with graded light output levels, so you can select the proper uniform light level for your application.

Lens Appearance

The 5082-4880 series is available in three different lens configurations. These are Red Diffused, Clear Diffused, and Clear.

The Red Diffused lens provides an excellent off/on contrast ratio. The Clear lens is designed for applications where a point source is desired. It is particularly useful where the light must be focused or diffused with external optics. The Clear Diffused lens is useful in masking the red color in the off condition.

LED SELECTION GUIDE

MINIMUM LIGHT OUTPUT (mcd)	LENS TYPE		
	Red Diffused Lens	Clear Plastic Lens	Clear Diffused Lens
0.5	5082-4880	5082-4883	5082-4886
1.0	5082-4881	5082-4884	5082-4887
1.6	5082-4882	5082-4885	5082-4888

MAXIMUM RATING (25°C)

DC Power Dissipation . . . . . .100 mW

DC Forward Current 50mA

Peak Forward Current . . . . . 1 Amp
(1 μsec pulse width, 300 pps)

Isolation Voltage (between lead and case) . . . 300V

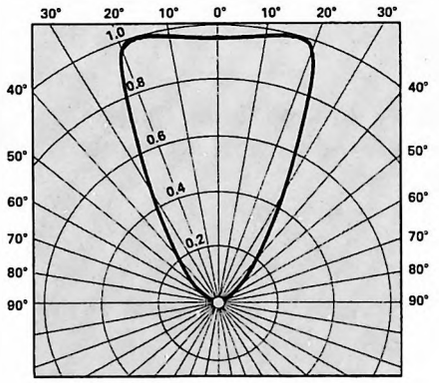
Operating and Storage
Temperature Range . . . . . –55°C to +100°C

Lead Soldering Temperature . . . . 230°C for 7 sec

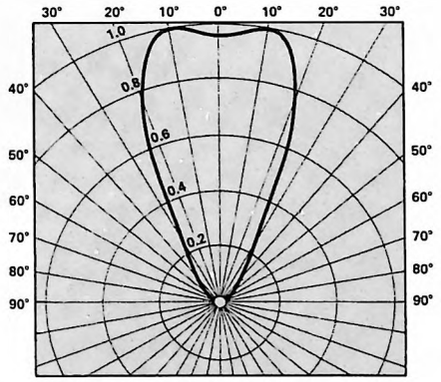
ELECTRICAL CHARACTERISTICS (25°C)

Symbol	Parameters	5082 - 4880 5082 - 4883 5082 - 4886			5082 - 4881 5082 - 4884 5082 - 4887			5082 - 4882 5082 - 4885 5082 - 4888			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Luminous Intensity	0.5	0.8		1.0	1.3		1.6	1.8		mcd	I_F = 20 mA
I_v	Luminous Intensity								0.8		mcd	I_F = 10 mA
λ_{pk}	Wavelength		655			655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10			10		ns	
C	Capacitance		200			200			200		pF	
θ_{JC}	Thermal Resistance		270			270			270		$^oC/W$	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0		1.6	2.0		1.6	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3	4		3	4		3	4		V	I_R = 10 μA

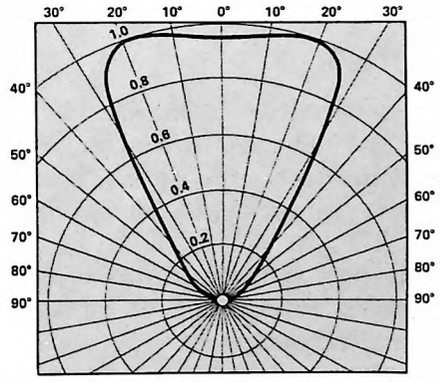
TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT



4880, 4881, 4882

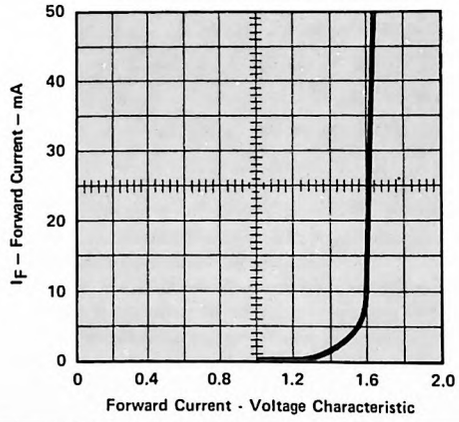


4883, 4884, 4885

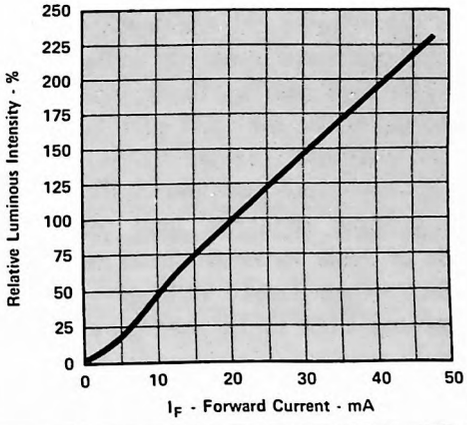


4886, 4887, 4888

FORWARD CURRENT VERSUS VOLTAGE CHARACTERISTIC



LUMINOUS INTENSITY VERSUS FORWARD CURRENT (I_F)



HEWLETT PACKARD

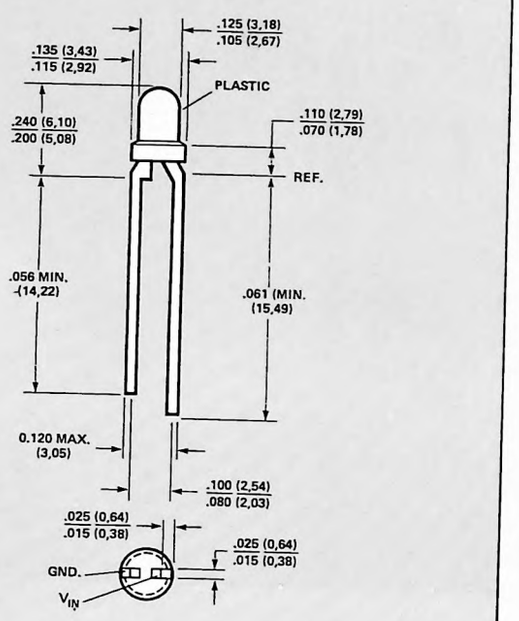
COMPONENTS

VOLTAGE SENSING LED

5082-4732

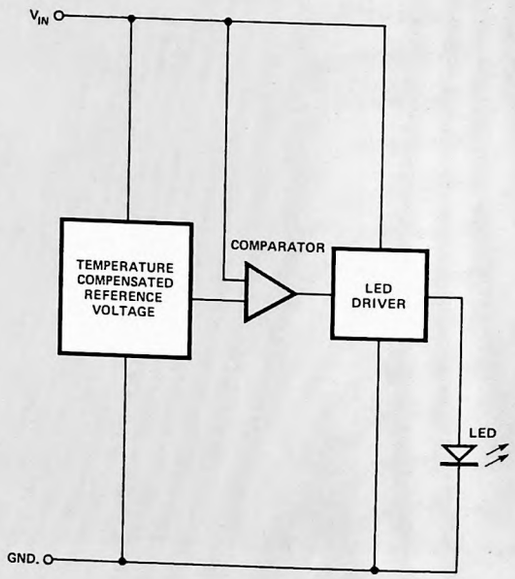
TENTATIVE DATA DECEMBER 1974

OUTLINE DRAWING



DIMENSIONS IN INCHES AND (millimeters).

BLOCK DIAGRAM



Features

- High sensitivity — 10mV on to off
- Built in LED current limiting
- Temperature compensated threshold voltage
- Compact — package includes integrated circuit and LED
- Guaranteed minimum luminous intensity
- Threshold voltage can be increased with external component

Description

The HP voltage sensing LEDs use an integrated circuit and a red GaAsP LED to provide a complete voltage sensing function in a standard red diffused T-1 LED package. When the input voltage (V_{IN}) exceeds the threshold voltage (V_{TH}) the LED turns "on". The high gain of the comparator provides unambiguous indication by the LED of the input voltage with respect to the threshold voltage. The V-I characteristics are resistive above and below the threshold voltage. This allows battery testing under simulated load conditions. Use of a resistor, diode or zener in series allows the threshold voltage to be increased to any desired voltage. A resistor in parallel allows the sensing LED to be used as a current threshold indicator.

The 5082-4732 has a nominal threshold voltage of 2.5V.

Applications

- Push-to-test battery voltage tester (pagers, cameras, appliances, radios, test equipment. . .)
- Logic level indicator
- Power supply voltage monitor
- V-U meter
- Analog level sense
- Voltage indicating arrays — use several with different thresholds
- Current monitor

Absolute Maximum Ratings

Storage Temperature	-55°C to +100°C
Operating Temperature	-55°C to +85°C
Lead Solder Temperature	230°C for 7 Sec
Input Voltage — V_{IN} [1]	+5V dc
Reverse Input Voltage — V_R	-0.5V

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 37mV/°C.

Electro-Optical Characteristics at $T_A = 25°C$

Parameter	Sym.	5082-4732 Min.	5082-4732 Typ.	5082-4732 Max.	Units	Test Conditions	Fig.
Threshold Voltage	V_{TH}	2.3	2.5	2.75	V		1,2
Temperature Coefficient of Threshold	$\frac{\Delta V_{TH}}{\Delta T_A}$		–1		mV/°C		
Input Current	I_{IN}		13		mA	$V_{IN} = 2.75V$	2
			33	50	mA	$V_{IN} = 5.0V$	2
Luminous Intensity	I_v	0.3	0.7		mcd	$V_{IN} = 2.75V$	1
Wavelength	λ_{pk}		655		nm	Measurement at peak	
Dominant Wavelength	λ_d		639		nm	Note 1	

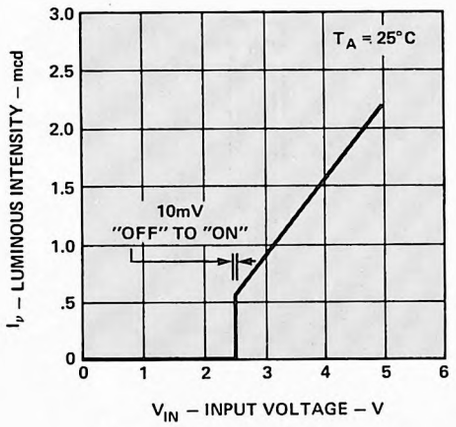


Figure 1. Luminous Intensity vs. Input Voltage.

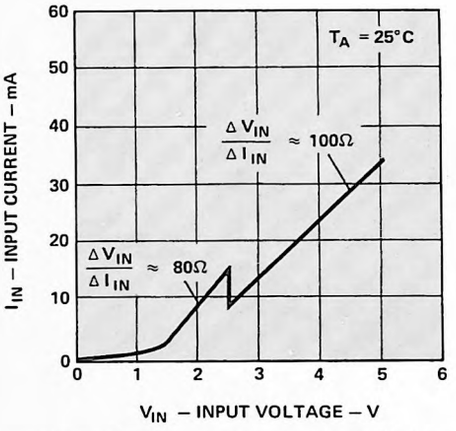

$T_A = 25°C$
$\frac{\Delta V_{IN}}{\Delta I_{IN}} \approx 100\Omega$
$\frac{\Delta V_{IN}}{\Delta I_{IN}} \approx 80\Omega$
I_{IN} – INPUT CURRENT – mA
V_{IN} – INPUT VOLTAGE – V

Figure 2. Input Current vs. Input Voltage.

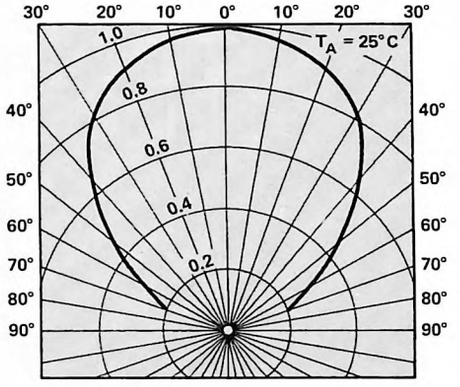
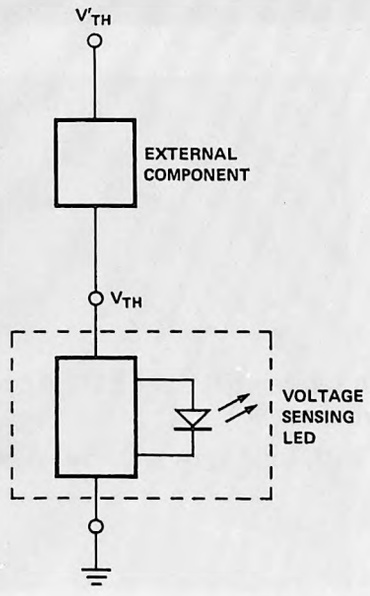


Figure 3. Relative Luminous Intensity vs. Angular Displacement.

Techniques For Increasing The Threshold Voltage



External Component	V'_{TH}	$TC = \frac{\Delta V_{TH}}{\Delta T_A}$ (mV/°C)
Schottky Diode (HP 5082-2835)	$V_{TH} + 0.45V$	-2
P-N Diode (1N914)	$V_{TH} + 0.75V$	-2.5
LED (HP 5082-4484)	$V_{TH} + 1.6V$	-2.9
Zener Diode	$V_{TH} + V_Z$	–1 + Zener TC
Series Resistor	$V_{TH} + I_{TH}R$ Note 2	Note 3

Notes:
1. The Dominant Wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which is perceived by the eye.
2. I_{TH} is the maximum current just below the threshold, V_{TH}. Since both I_{TH} and V_{TH} are variable, a precise value of V'_{TH} is obtainable only by selecting R to fit the measured characteristics of the individual devices (e.g., with curve tracer).
3. The temperature coefficient (TC) will be a function of the resistor TC and the value of the resistor.

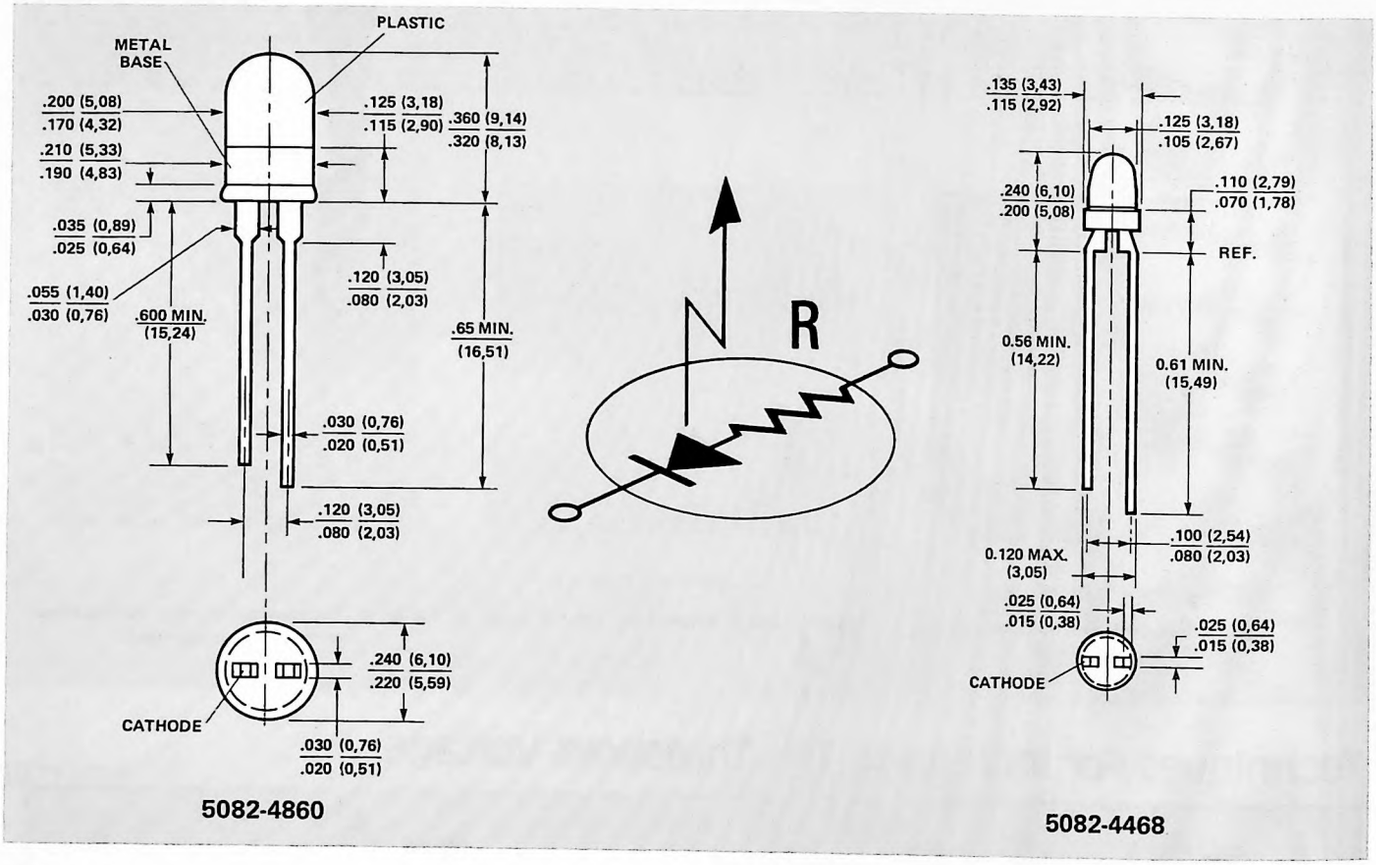
HEWLETT hp PACKARD

COMPONENTS

RESISTOR LEDs

5082-4860
5082-4468

TECHNICAL DATA JANUARY 1975



Features

- TTL COMPATIBLE – 16mA @ 5 VOLTS TYPICAL
- INTEGRAL CURRENT LIMITING RESISTOR
- T-1 (.125") SIZE AND T-1¾ (.200") SIZE
- RUGGED AND RELIABLE

Description

The HP Resistor-LED series provides an integral current limiting resistor in series with the LED. Applications include panel mounted indicators, cartridge indicators, and lighted switches.

The 5082-4860 is a standard red diffused .200" diameter (T-1¾ size) LED, with long wire wrappable leads.

The 5082-4468 is a clear diffused .125" diameter (T-1 size) LED.

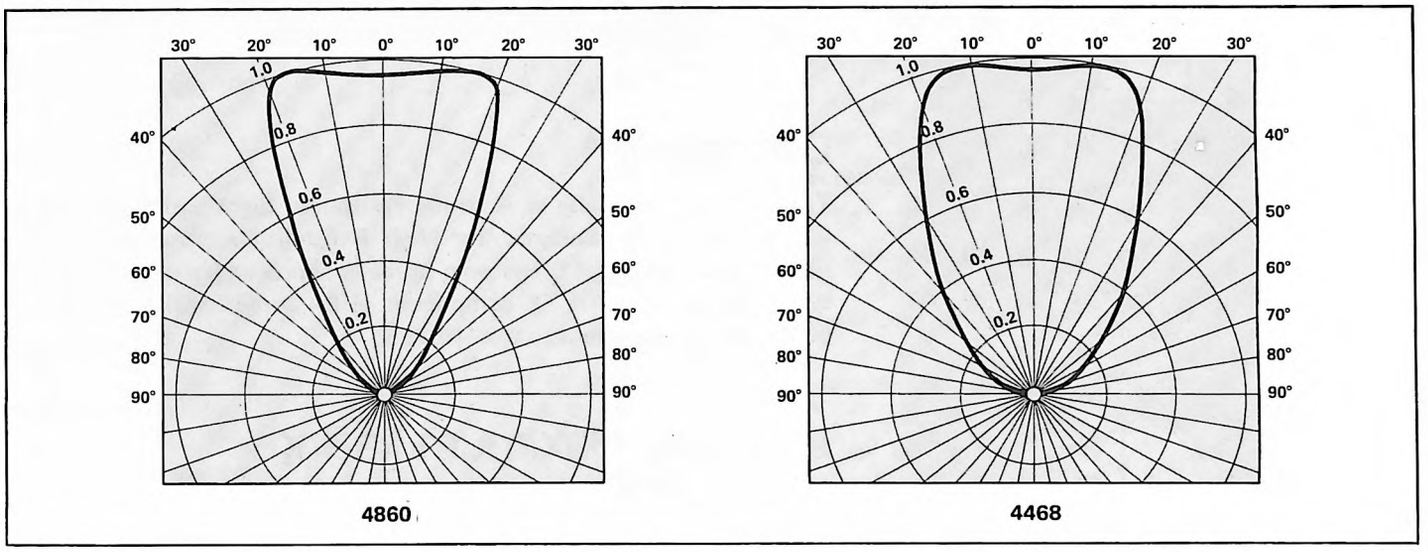
Maximum Ratings (T_A = 25°C unless otherwise stated)

DC Forward Voltage [Derate linearly to 5V @ 100°C]	7.5V
Reverse Voltage	7V
Isolation Voltage [between lead and base of the 5082-4860]	300V
Operating and Storage Temperature Range	–55°C to +100°C
Lead Soldering Temperature	230°C for 7 sec.

Electrical Characteristics at T_A=25°C

Symbol	Parameters	5082-4860/-4468			Units	Test Conditions
		Min.	Typ.	Max.		
I_v	Luminous Intensity	0.3	0.8		mcd	V_F = 5.0V
λ_{pk}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
I_F	Forward Current		16	20	mA	V_F = 5.0V
BV_R	Reverse Breakdown Voltage	3			V	I_R = 10μA

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT



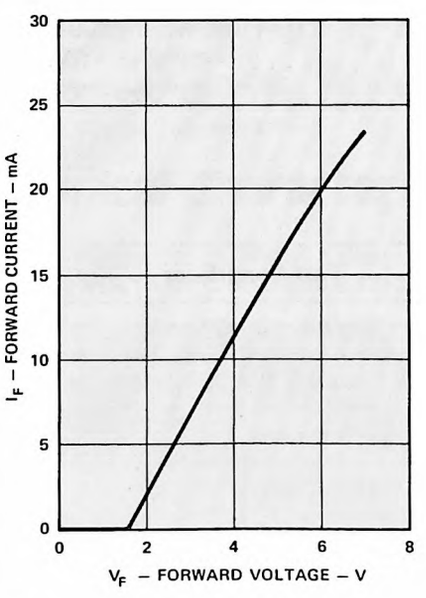


Figure 1. Typical DC Forward Current – Voltage Characteristic

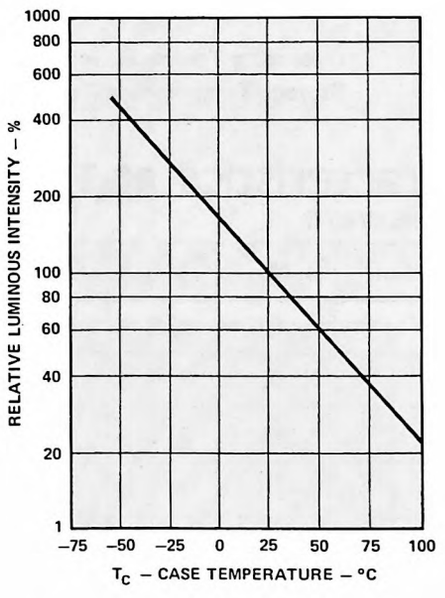


Figure 2. Relative Luminosity vs. Case Temperature

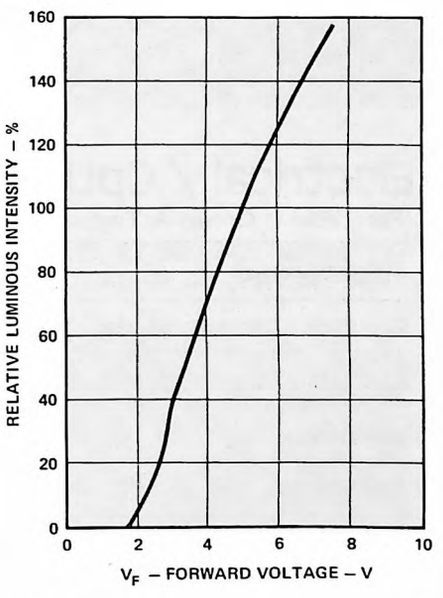


Figure 3. Relative Luminous Intensity vs. Voltage

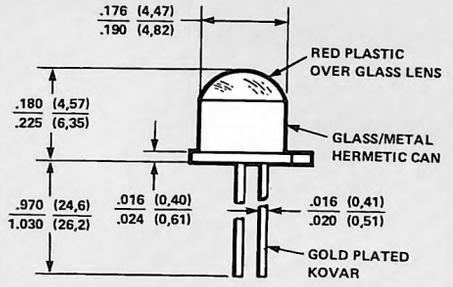
HEWLETT hp PACKARD

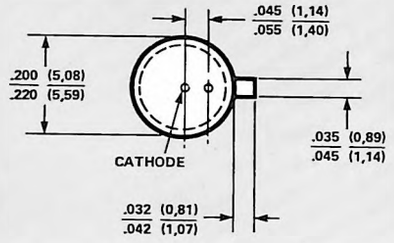
COMPONENTS

LIGHT EMITTING DIODE MILITARY APPROVED MIL-S-19500/467

1N5765
JAN 1N5765
JAN TX 1N5765

TECHNICAL DATA AUGUST 1973





Features

- Designed for High-Reliability Applications
- Hermetically Sealed
- Long Life
- High Brightness Over a Wide Viewing Angle
- IC Compatible/Low Power Consumption

Description

The 1N5765 is a Gallium Arsenide Phosphide Light Emitting Diode, Solid State Lamp, designed for High Reliability applications. This hermetically sealed LED has been formally approved for use in military systems as a JAN/JAN TX component. HPA commercial part number 5082-4420 is equivalent to the 1N5765.

Absolute Maximum Ratings at T_A=25°C

Breakdown Voltage 4Vdc
Forward Current [see Note 1] 50mAdc
Power Dissipation 150mW
Peak Forward Current . . . . . 3 Amp
(1μs Pulse Width, 300pps)
Operating Temperature Range . . . . . −65°C to +100°C
Storage Temperature Range . . . . . −65° C to +100°C

Electrical / Optical Characteristics at T_A=25°C

(Per Table I, Group A Testing of MIL-S 19500/467)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Luminous Intensity (Axial)	I_{v1}	0.5	3.0	mcd	I_F = 20mAdc, θ = 0°
Luminous Intensity (off Axis)	I_{v2}	0.3		mcd	I_F = 20mAdc, θ = 30° [see Note 2]
Wavelength	λ_v	630	700	nM	Design Parameter
Capcitance	C		300	pF	V_R = 0, f = 1MHz
Forward Voltage	V_F		2.0	Vdc	I_F = 20mAdc
Reverse Current	I_R		1	μAdc	V_R = 3Vdc [see Note 2]

NOTES:

1. Derate 0.67 mAdc/°C for T_A above 25°C.
2. These specifications apply only to JAN/JAN TX levels.

JAN 1N5765: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/467. A summary of the data gathered in Groups A, B, and C lot acceptance testing is supplied with each shipment.

JAN TX 1N5765: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/467. The JAN TX lot is then subjected to Group A, Group B and Group C tests as for the JAN 1N5765 above. A summary of the data gathered in Groups A, B and C acceptance testing is supplied with each shipment.

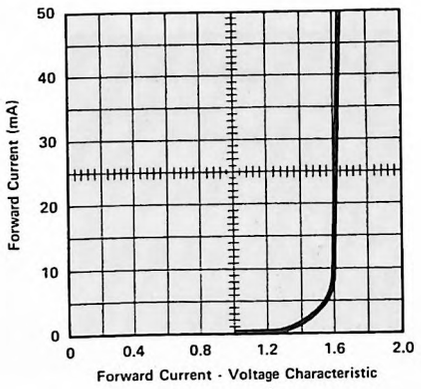
Group B Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066
Solderability	2026
Thermal Shock	1056A
Temperature Cycling	1051A
Fine Leak Test	1071H
Gross Leak Test	1071C
Moisture Resistance	1021
Mechanical Shock	2016
Vibration	2056
Constant Acceleration	2006
Terminal Strength	2036E
Salt Atmosphere	1041
Temp. Storage (100°C, 340 hours)	1032
Operating Life (50mAdc, 340 hours)	1027

Group C Sample Acceptance Tests	Method MIL-STD-750
Low Temp. Operation (–55°C)	
Breakdown Voltage	4021
Temperature Cycling	1051A
Resistance to Solvents	*
Temp. Storage (100°C, 1K hours)	1031
Operating Life (50mAdc, 1K hours)	1026
Peak Forward Pulse Current	
TX Screening (100%)	
Temp. Storage (100°C, 72 hours)	
Temperature Cycling	1051A
Constant Acceleration	2006
Fine Leak Test	1071H
Gross Leak Test	1071C
Burn-in (50mAdc, 168 hours)	
Evaluation of Drift (I_{V1}, V_F, I_R)	

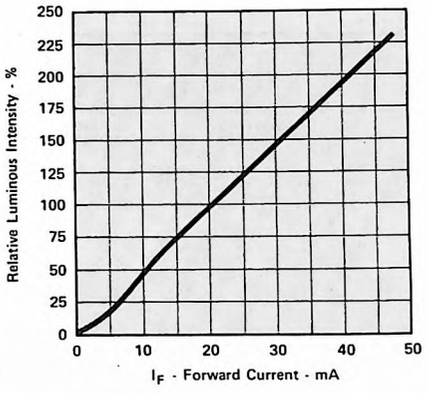
*MIL-STD-202 Method 215

Typical Characteristic Curves

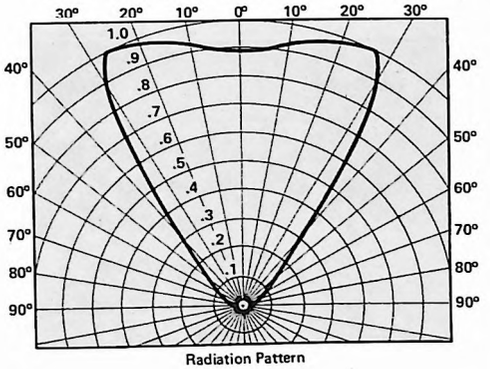
FORWARD CURRENT VERSUS VOLTAGE CHARACTERISTIC



LUMINOUS INTENSITY VERSUS FORWARD CURRENT (I_F)



RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT



HEWLETT hp PACKARD

COMPONENTS

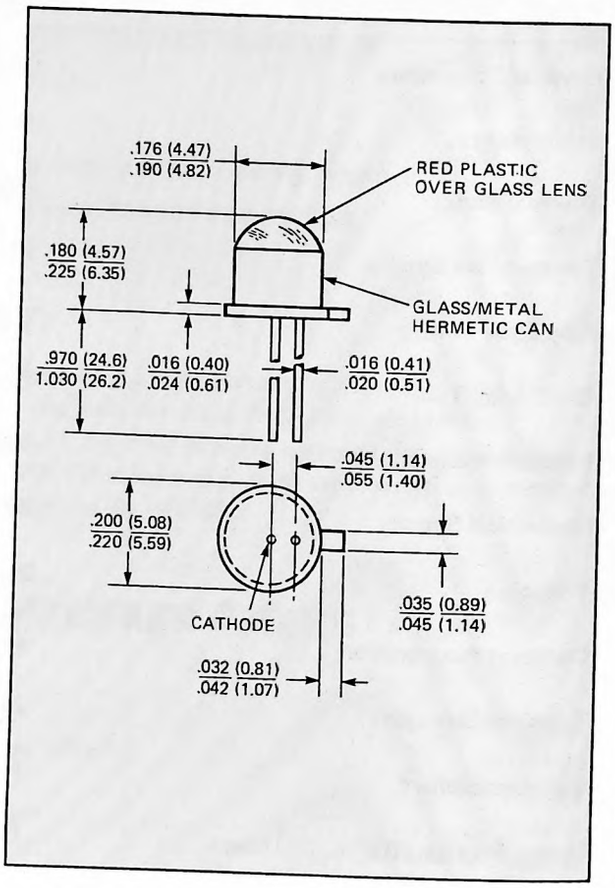
LIGHT EMITTING DIODE FOR HIGH-RELIABILITY APPLICATIONS

5082-4420

TECHNICAL DATA SEPT 1971

FEATURES

- DESIGNED FOR HIGH-RELIABILITY ENVIRONMENTS
- HERMETICALLY SEALED
- LONG LIFE
- HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE
- IC COMPATIBLE/LOW POWER CONSUMPTION



DESCRIPTION

5082-4420 – High performance Light Emitting Diode designed for high-reliability applications.

MAXIMUM RATINGS (25°C)

DC Power Dissipation ..... 85 mW

DC Forward Current ..... 50 mA

Peak Forward Current ..... 1 Amp
(1 μsec pulse width, 300 pps)

Isolation Voltage (between lead and case) ..... 500 V

Operating and Storage
Temperature Range ..... −55°C to +100°C

Lead Soldering Temperature ..... 230°C for 7 sec

ELECTRICAL CHARACTERISTICS (25°C)

Symbol	Parameters	5082-4420			Units	Test Conditions
		Min.	Typ.	Max.		
I	Luminous Intensity	500		3000	μcd	I_F = 20 mA
λ_{pk}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		10		ns	
c	Capacitance		200	300	pF	V = 0 f = 1MHz
V_F	Forward Voltage		1.6	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	4	5		V	I_R = 10 μA

HEWLETT hp PACKARD

COMPONENTS

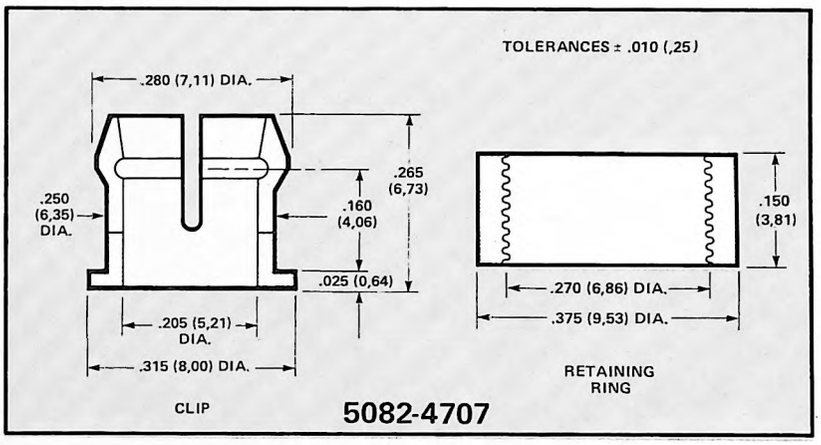
CLIP AND RETAINING RING FOR PANEL MOUNTED LEDs

5082-4707

TECHNICAL DATA FEB. 1974

Description

The 5082-4707 is a black plastic mounting clip and retaining ring. It is designed to panel mount Hewlett Packard Solid State T-1¾ size lamps. This clip and ring combination is intended for installation in instrument panels up to .125" thick. For panels greater than .125", counterboring is required to the .125" thickness.



5082-4707

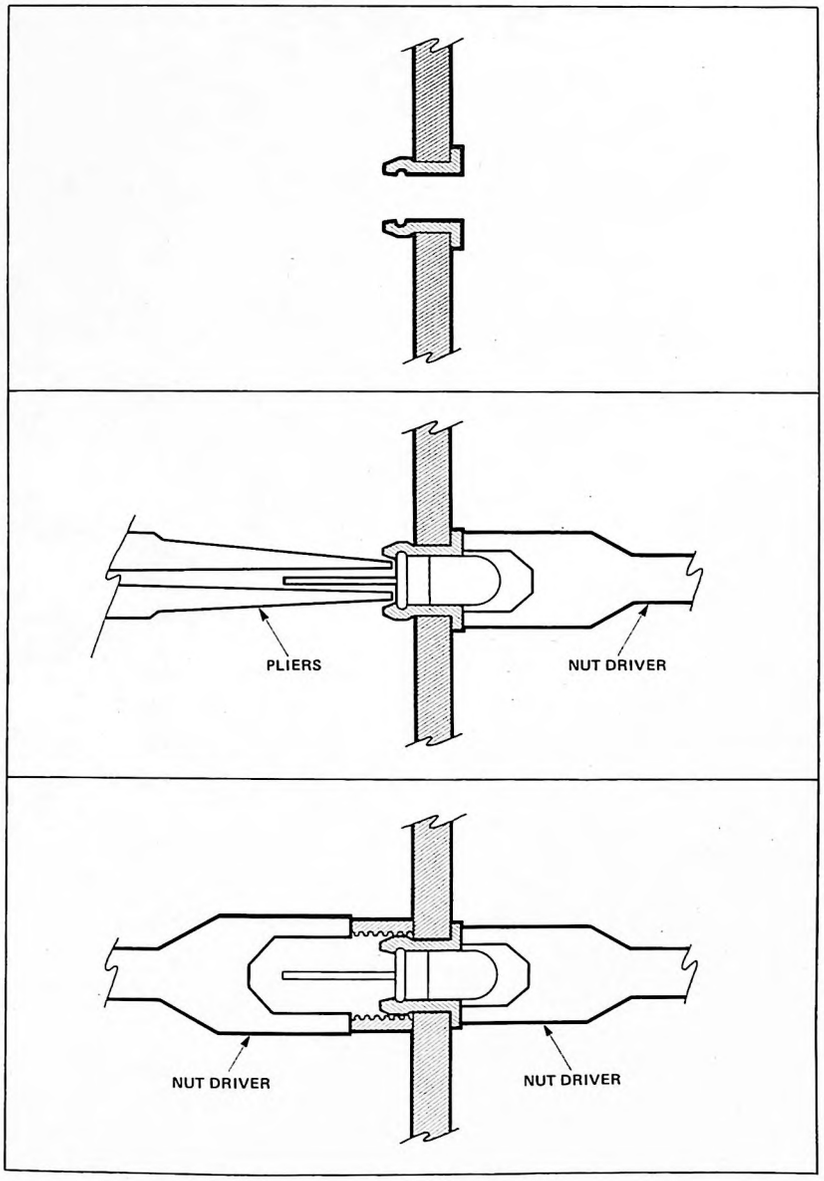
Mounting Instructions

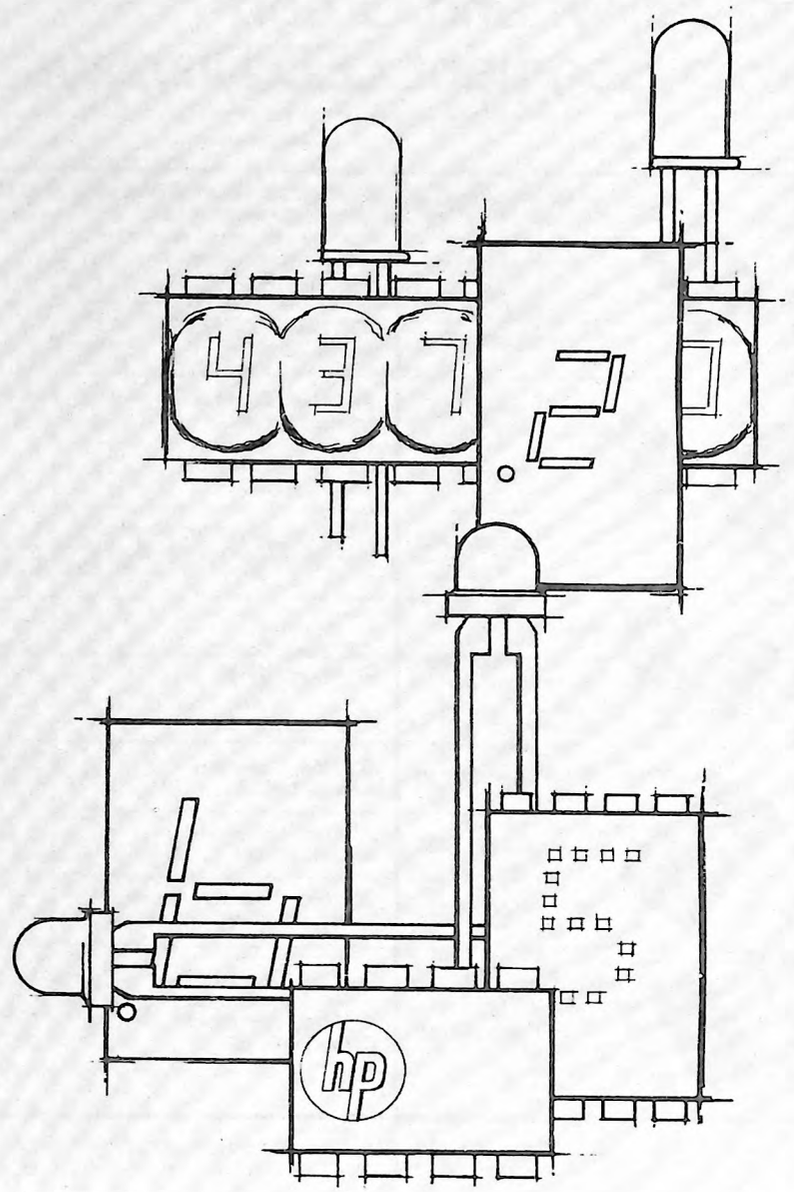
1. Drill a .250" dia. hole in the panel. Deburr but do not chamfer the edges of the hole.

2. Press the panel clip into the hole from the front of the panel.

3. Press the LED into the clip from the back. Use blunt long nose pliers to push on the LED. Do not use force on the LED leads. A tool such as a nut driver may be used to press on the clip.[1]

4. Slip a plastic retaining ring onto the back of the clip and press tight using tools such as two nut drivers.





LED Displays

Selection Guide 36

Red, Yellow and Green Seven Segment LED Displays:

0.43" High Efficiency Red, Yellow and Green Displays, 5082-7650/60/70 38

0.43" Common Anode Red Displays, 5082-7750 Series 42

0.43" Common Cathode Red Display, 5082-7760 46

0.3" Common Anode Red Displays, 5082-7730 Series 49

0.3" Common Cathode Red Display, 5082-7740 53

0.11" Solid State Numeric Indicator, 5082-7400 Series 55

0.11" Solid State Numeric Indicator, 5082-7430 Series 59

0.105" Eight or Nine Digit Numeric Indicators, 5082-7440 Series 63

Commercial Integrated LED Displays:

0.29" Numeric and Hexadecimal Indicators, 5082-7300 Series 67

1.5" Numeric Indicator, 5082-7500 71

Hermetically Sealed Integrated LED Displays:

0.27" Numeric Indicators (1 Digit), 5082-7010/11 73

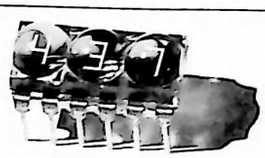
0.27" Numeric Indicator (3 Digits), 5082-7001 79

Alphanumeric LED Displays:

0.27" 5 x 7 X-Y Addressable, 5082-7100/1/2 80

Red, Yellow and Green Seven Segment LED Displays

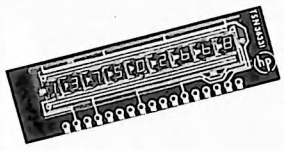
HEWLETT hp PACKARD
COMPONENTS

Device		Description	Package	Application	Page No.
	5082-7650	.43" High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, .3" DIP .75"H x .5"W x .25"D	General Purpose Market • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 (See page 117)	38
	5082-7660	.43" Yellow, Common Anode, LHDP			
	5082-7670	.43" Green, Common Anode, LHDP			
	5082-7750	.43" Red, Common Anode, LHDP	14 Pin Epoxy, .3" DIP .75"H x .5"W x .25"D		42
	5082-7751	.43" Red, Common Anode, RHDP			
	5082-7752	.43" Red, Common Anode, Polarity & Overflow Indicator			45
	5082-7760	.43" Red, Common Cathode, RHDP	14 Pin Epoxy, .3" DIP .75"H x .5"W x .25"D		46
	5082-7730	.3" Red, Common Anode, LHDP	14 Pin Epoxy, .3" DIP .75"H x .4"W x .18"D		49
	5082-7731	.3" Red, Common Anode, RHDP			
	5082-7732	.3" Red, Common Anode, Polarity & Overflow Indicator			52
	5082-7740	.3" Red, Common Cathode, RHDP	10 Pin Epoxy, .3" DIP .75"H x .4"W x .18"D		53
	5082-7402	.11" Red, 3 Digits Right, [1] Centered Decimal Point	12 Pin Epoxy, .3" DIP	Small Display Market • Portable/Battery Power Instruments • Portable Calculators For further information ask for Application Note 937 (See page 117)	55
	5082-7403	.11" Red, 3 Digits Left, [1] Centered Decimal Point			
	5082-7404	..11" Red, 4 Digits, Centered Decimal Point			
	5082-7405	.11" Red, 5 Digits, Centered Decimal Point	14 Pin Epoxy, .3" DIP		
	5082-7412	.11" Red, 3 Digits Right, [1] RHDP	12 Pin Epoxy, .3" DIP		
	5082-7413	.11" Red, 3 Digits Left, [1] RHDP			
	5082-7414	.11" Red, 4 Digit, RHDP			
	5082-7415	.11" Red, 5 Digit, RHDP	14 Pin Epoxy, .3" DIP		
	5082-7432	.11" Red, 2 Digits Right, [2] RHDP	12 Pin Epoxy, .3" DIP		59
	5082-7433	.11" Red, 3 Digits, RHDP			

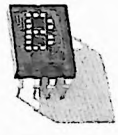
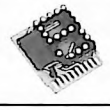
NOTES: 1. Three Digit Displays are mounted in four-digit packages with digits placed to the left or right.
2. Two Digit Displays are mounted in three-digit packages with digits placed to the right.

Red, Yellow and Green Seven Segment LED Displays (Continued)

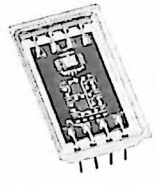
HEWLETT hp PACKARD
COMPONENTS

Device		Description	Package	Application	Page No.
	5082-7440	.105" Red, 8 Digits, Mounted on P.C. Board	17 Term. P.C. Bd., 2,000" W., Edge Card Connector	Small Display Market • Portable/Battery Power Instruments • Portable Calculators For further information ask for Application Note 937 (See page 117)	63
	5082-7448	.105" Red, 8 Digits, Mounted on P.C. Board	17 Term. P.C. Bd., 2,375" W., Edge Card Connector		
	5082-7441	.105" Red, 9 Digits, Mounted on P.C. Board	17 Term. P.C. Bd., 2,000" W., Edge Card Connector		
	5082-7449	.105" Red, 9 Digits, Mounted on P.C. Board	17 Term. P.C. Bd., 2,375" W., Edge Card Connector		

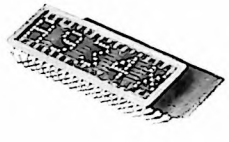
Commercial Integrated LED Displays

Device		Description	Package	Application	Page No.
	5082-7300	.29" 4 x 7 Single Digit Numeric, RHDP, Built-In Decoder/Driver/Memory	8 Pin Epoxy, .6" DIP .55"H x .4"W x .11"D	General Purpose Market • Test Equipment • Business Machines • Medical • Computer Peripherals • Avionics For further information ask for Application Note 934 (See page 117)	67
	5082-7302	.29" 4 x 7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory			
	5082-7340	.29" 4 x 7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory			
	5082-7304	.29" Overrange Character Plus/Minus Sign	8 Pin Epoxy, .6" DIP .55"H x .4"W x .11"D		70
	5082-7500	1.5" 5 x 7 Single Digit LHDP, Built-In Decoder/ Driver	P.C. Board 10 Pin Edge Card Connector (.156" Centers)	General Purpose Market • Test Equipment • Medical Equipment • Industrial Controls	71

Hermetically Sealed Integrated LED Displays

Device		Description	Package	Application	Page No.
	5082-7010	.27" 5 x 7 Single Digit Numeric, LHDP, Built-In Decoder/Driver	8 Pin Hermetic .100" Pin Centers	• Ground, Airborne, Shipboard Equipment • Fire Control Systems • Medical Instruments • Space Flight Systems	73
	5082-7011	.27" Plus/Minus Sign			
	5082-7001	.27" 5 x 7 Three Digit Numeric, LHDP, Built-In Decoder/Driver	24 Pin Hermetic .100" Pin Centers		79

Alphanumeric LED Displays

Device		Description	Package	Application	Page No.
	5082-7100	.29" 5x7 Three Digit Alphanumeric	22 Pin Hermetic .6" DIP	General Purpose Market • Business Machines • Calculators • Solid State CRT • High Reliability Applications For further information ask for Application Note 931 (See page 117)	80
	5082-7101	.29" 5x7 Four Digit Alphanumeric	28 Pin Hermetic .6" DIP		
	5082-7102	.29" 5x7 Five Digit Alphanumeric	36 Pin Hermetic .6" DIP		

HEWLETT hp PACKARD

COMPONENTS

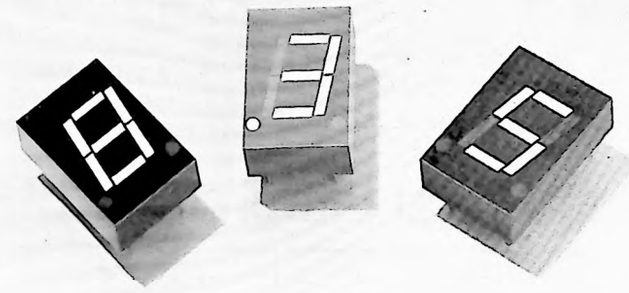
.43 INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED • 5082-7650
YELLOW • 5082-7660
GREEN • 5082-7670

TENTATIVE DATA JANUARY 1975

Features

- LARGE DIGIT
  - Viewing up to 20 Feet
- CHOICE OF 3 BRIGHT COLORS
  - Green
  - Red
  - Yellow
- LOW CURRENT OPERATION
  - As Low As 3mA per Segment
  - Multiplex Operation
- EXCELLENT CHARACTER APPEARANCE
  - Evenly Lighted Segments
  - Wide Viewing Angle
  - Body Color Improves "Off" Segment Contrast
- EASY MOUNTING ON PC BOARD OR SOCKETS
  - Industry Standard .3" DIP Leads on 0.1" Centers
- CATEGORIZED FOR LUMINOUS INTENSITY
  - Stacking of Like Categories Yields a Uniform Display
- IC COMPATIBLE
- MECHANICALLY RUGGED



Description

The 5082-7650, -7660 and -7670 are large .43" Red, Yellow and Green common anode seven-segment displays with left hand decimal point. These displays are designed for use in Instruments, P.O.S. Terminals, Clocks and Appliances.

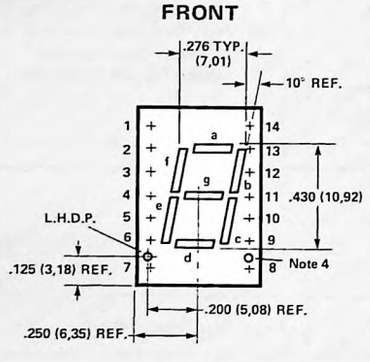
The -7650 and -7660 utilize high efficiency LED chips which are made from GaAsP on a transparent GaP substrate.

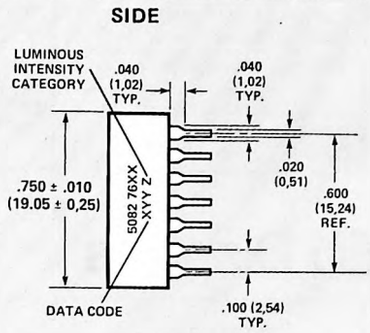
The -7670 utilizes chips made from GaP on a transparent GaP substrate.

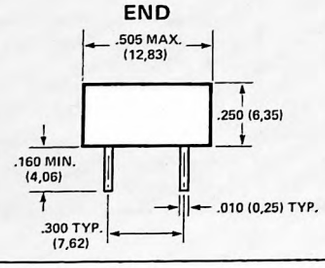
The following additional standard products are available upon request from HPA Division of Hewlett Packard.

	Red	Yellow	Green
Common Anode, R.H.D.P.	-7651	-7661	-7671
Common Anode, ±1 Overflow	-7652	-7662	-7672
Common Cathode, R.H.D.P.	-7653	-7663	-7673

Package Dimensions







PIN	FUNCTION 5082-7650, -7660, -7670
1	CATHODE - a
2	CATHODE - f
3	ANODE[3]
4	NO PIN
5	NO PIN
6	CATHODE - dp
7	CATHODE - e
8	CATHODE - d
9	NO CONN.
10	CATHODE - c
11	CATHODE - g
12	NO PIN
13	CATHODE - b
14	ANODE[3]

NOTES:

1. Dimensions in inches and (millimeters).
2. Tolerances on all dimensions are ±.015" (±0,38) unless otherwise specified.
3. Redundant anodes.
4. Unused dp position.

Absolute Maximum Ratings

Parameter	Hi-Eff. Red 7650	Yellow 7660	Green 7670	Units
Continuous Power Dissipation Per Segment or D.P.[1] $T_A = 25°C$	67[2]	67[2]	67[2]	mW
Operating Temperature Range	-20 to +85	-20 to +85	-20 to +85	°C
Storage Temperature Range	-20 to +85	-20 to +85	-20 to +85	°C
Peak Forward Current/Segment or D.P.[3] $T_A = 25°C$	60	60	60	mA
Average Forward Current/Seg. or D.P.[1,2] $T_A = 25°C$	20	20	20	mA
Reverse Voltage/Segment or D.P.	6.0	6.0	6.0	V
Max. Solder Temp. 1/16" Below Seating Plane [4] $t \leqslant 5$ secs.	230	230	230	°C

Electrical/Optical Characteristics at $T_A = 25°C$

HIGH EFFICIENCY RED 5082-7650

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8] (Digit Average)	I_v	5mA D.C.	150	300		µcd
		20mA D.C.		1720		µcd
		60mA Pk: 1 of 6 Duty Factor		970		µcd
Peak Wavelength	λ_P			635		nm
Dominant Wavelength[6]	λ_D			626		nm
Forward Voltage any Segment or D.P.	V_F	$I_F = 60mA$		2.7	3.3	V
		$I_F = 5mA$		1.9		
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		10		µA
Response Time[7]	t_r, t_f			90		ns
Temperature Coefficient of V_F	$\Delta V_F/°C$			-2.0		mV/°C

YELLOW 5082-7660

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8] (Digit Average)	I_v	5mA D.C.	100	250		µcd
		20mA D.C.		1500		µcd
		60mA Pk: 1 of 6 Duty Factor		925		µcd
Peak Wavelength	λ_P			583		nm
Dominant Wavelength[6]	λ_D			585		nm
Forward Voltage any Segment or D.P.	V_F	$I_F = 60mA$		2.7	3.3	V
		$I_F = 5mA$		1.9		
Reverse Current/Segment or D.P.	I_R	$V_R = 6V$		10		µA
Response Time[7]	t_r, t_f			90		ns
Temperature Coefficient of V_F	$\Delta V_F/°C$			-2.0		mV/°C

GREEN 5082-7670

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [5,8] (Digit Average)	I_v	10mA D.C.	125	250		μcd
		20mA D.C.		640		μcd
		60mA Pk: 1 of 6 Duty Factor		450		μcd
Peak Wavelength	λ_P			565		nm
Dominant Wavelength [6]	λ_D			572		nm
Forward Voltage any Segment or D.P.	V_F	I_F = 60mA		2.8	3.3	V
		I_F = 10mA		2.1		
Reverse Current/Segment or D.P.	I_R	V_R = 6V		10		μA
Response Time [7]	t_r, t_f			90		ns
Temperature Coefficient of V_F	$\Delta V_F/°C$			-2.0		mV/°C

NOTES: 1. See pwr. derating curve (Fig. 6). 2. Derate from 50°C at 0.4mA/°C per segment. 3. See pulse width limitation curve (Fig. 2) and Duty Factor Curve (Fig. 5). 4. Clean only in Water, Isoproponal, Ethanol, Freon TF, Freon TE. 5. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package. 6. The dominant wavelength, λ_D, is derived from the C.I.E. chromaticity diagram and that single wavelength which is perceived by the eye. 7. Time for a 10%-90% change of light intensity for step change in current. 8. Temperature coefficient of luminous intensity $\Delta I_v/°C$ is determined by the formula $I_{T_A} = I_{25°C}$ (.982) (T_A = 25°C).

Operational Considerations

ELECTRICAL

The 5082-7600 series of display products are arrays of eight light emitting diodes which are optically magnified to form seven individual segments plus a decimal point.

The diodes in these displays utilize a Gallium Arsenide Phosphide junction on a Gallium Phosphide substrate to produce high efficiency yellow and red emission spectra and a Gallium Phosphide junction for the green. In the case of the red displays, efficiency is improved by at least a factor of 4 over the standard Gallium Arsenide Phosphide based technology. The use of Gallium Phosphide as the substrate does result in an internal dynamic resistance in the range of 10-20Ω. It is this resistance which causes the substantially higher forward voltage specifications in the new devices.

The user should be careful to scale the appropriate forward voltage from the V_F versus I_F curve, Figure 4, when designing for a particular forward current. Another way to obtain V_F would be to use the following formula:
$V_F = 1.9V + 15\Omega\ (I_F - 5mA)$.

These displays may be operated in the strobed mode at currents up to 60mA peak. Figures 2 and 5 provide the designer with recommended maximum duty factor and pulse width design criteria for strobed operation. When operating at peak currents above 5mA for red and yellow or 10mA for green, there will be an improvement in the relative efficiency of the display. Light output at higher currents can be calculated using the following relationship:

$$I_v = I_{v\ spec}\ K\ \frac{I_{AVG}}{I_{SPEC}}$$

where I_v = luminous intensity at the desired I_{AVG}

$I_{v\ SPEC}$ = specified luminous intensity from the data sheet.

I_{AVG} = Average forward segment current. For strobed displays I_{AVG} = (duty factor) (I_{PEAK}).

K = efficiency factor at peak forward current, from Figure 3, divided by efficiency factor at I_{SPEC}, from Figure 3.

I_{SPEC} = current at which I_v is specified.

CONTRAST ENHANCEMENT

The 5082-7600 series devices have been optimized for use in actual display systems. In order to maximize "ON-OFF" contrast, the bodies of the displays have been painted to match the appearance of an unilluminated segment. The emission wavelength of the red displays has been shifted from the standard GaAsP – 655nm to 635nm in order to provide an easier to read device.

All of the colored display products should be used in conjunction with contrast enhancing filters. Some suggested contrast filters – for red displays, Panelgraphic Red 60 or Homalite 1670; for yellow displays, Panelgraphic Yellow 25, Amber 23, or Homalite (100-1720, 100-1726); for green, Panelgraphic Green 48. Another excellent contrast enhancement material for all colors is the 3M light control film with the crosshatched louvers.

MECHANICAL

The 5082-7600 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 500 mil centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame has an integral seating plane which will hold the package approximately .035" above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only Freon TF, Freon TE, (for Freons, up to 2 min. max. at boiling temp.), Isoproponal, Ethanol or water be used for cleaning operations.

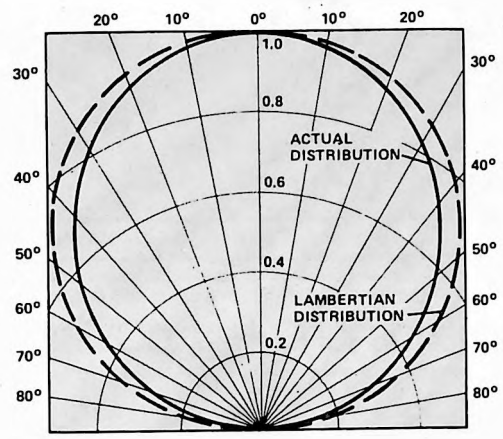


Figure 1. Normalized Angular Distribution of Luminous Intensity.

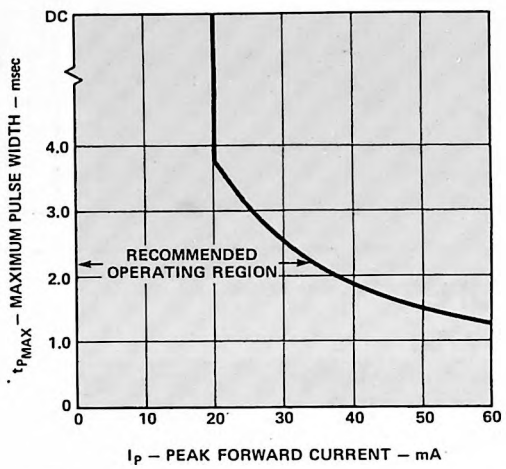


Figure 2. Maximum Allowable Pulse Width as a Function of Peak Forward Current.

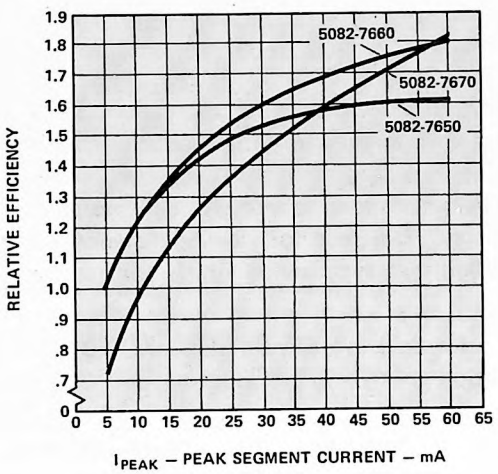


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) versus Peak Segment Current.

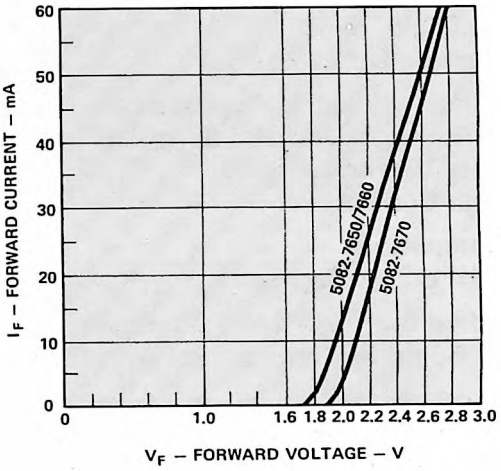


Figure 4. Forward Current versus Forward Voltage Characteristic.

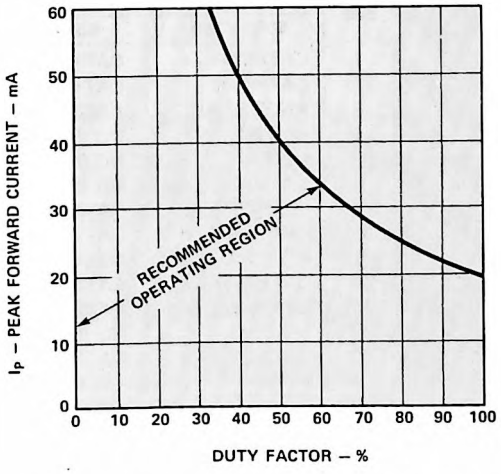


Figure 5. Maximum Peak Forward Current as a Function of Duty Factor.

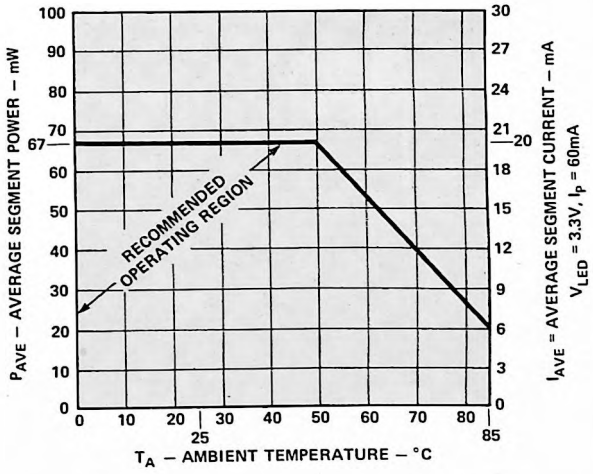


Figure 6. Allowable Segment Power Dissipation as a Function of Ambient Temperature.

HEWLETT hp PACKARD

COMPONENTS

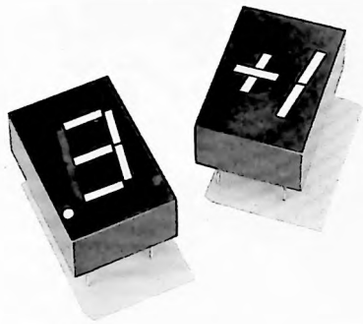
.43" SOLID STATE SEVEN SEGMENT INDICATORS

5082-7750 SERIES

TECHNICAL DATA NOVEMBER 1974

Features

- 5082-7750
  - — Common Anode
  - — Left Hand D.P.
- 5082-7751
  - — Common Anode
  - — Right Hand D.P.
- 5082-7752
  - — Common Anode
  - — Polarity and Overflow Indicator
- Large Digit
  - — Viewing Up to 20 Feet
- Excellent Character Appearance
  - — Continuous Uniform Segments
  - — Wide Viewing Angle
  - — High Contrast
- IC Compatible
  - — 1.6V dc per Segment
- Standard 0.3" DIP Lead Configuration
  - — PC Board or Standard Socket Mountable
- Categorized for Luminous Intensity
  - — Assures Uniformity of Light Output from Unit to Unit within a Single Category

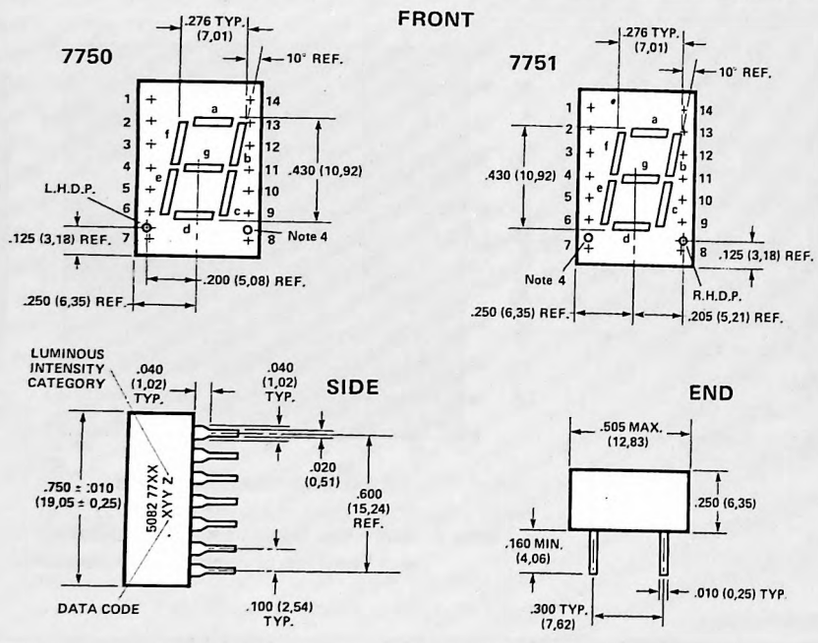


Description

The HP 5082-7750 series devices are common anode LED displays. The series includes a left hand and a right hand decimal point numeric display as well as a polarity and overflow indicator. This large .43" high character presents a bright, continuously uniform seven segment display. Designed for viewing distances of up to 20 feet, these single digit displays provide a high contrast ratio and a wide viewing angle.

The 5082-7750 series devices utilize a standard 0.3" dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Package Dimensions



PIN	FUNCTION [5]	
	5082-7750	5082-7751
1	CATHODE - a	CATHODE - a
2	CATHODE - f	CATHODE - f
3	ANODE [3]	ANODE [3]
4	NO PIN	NO PIN
5	NO PIN	NO PIN
6	CATHODE - dp	NO CONN. [5]
7	CATHODE - e	CATHODE - e
8	CATHODE - d	CATHODE - d
9	NO CONN. [5]	CATHODE - dp
10	CATHODE - c	CATHODE - c
11	CATHODE - g	CATHODE - g
12	NO PIN	NO PIN
13	CATHODE - b	CATHODE - b
14	ANODE [3]	ANODE [3]

NOTES:
1. Dimensions in inches and (millimeters).
2. Tolerances on all dimensions are ±.015" (±0,38) unless otherwise specified.
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram.

Absolute Maximum Ratings

Power Dissipation T_A = 25°C	400mW
Operating Temperature Range	−20°C to +85°C
Storage Temperature Range	−20°C to +85°C
Average Forward Current/Segment or Decimal Pt. T_A = 25°C [1]	25mA
Peak Forward Current/Segment or Decimal Pt. T_A = 25°C (Pulse Duration ≤ 500μs)	150mA
Reverse Voltage/Segment or Decimal Pt.	6V
Max. Solder Temperature 1/16" Below Seating Plane (t ≤ 5 sec.) [2]	230°C

NOTES: 1. Derate from 25° C at 0.25 mA/° C per segment of D.P. 2. Clean only in Freon TE, Freon TF, Isopropanol, ethanol or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1] (Digit Average)	I_v	I_{PEAK} = 100mA 12.5% Duty Cycle		350		μcd
		I_F = 20mA	150	400		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_D			645		nm
Forward Voltage, any Segment or D.P.	V_F	I_F = 20mA		1.6	2.0	V
Reverse Current, any Segment or D.P.	I_R	V_R = 6V		10		μA
Rise and Fall Time [3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	ΔV_F/°C			−2.0		mV/°C
Temperature Coefficient of Luminous Intensity	ΔI_v/°C			−1.0		%/°C

NOTES:

1. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
2. Dominant wavelength, λ_D, is that wavelength which passes through the centroid of a photopically weighted spectral distribution. This wavelength defines the color perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

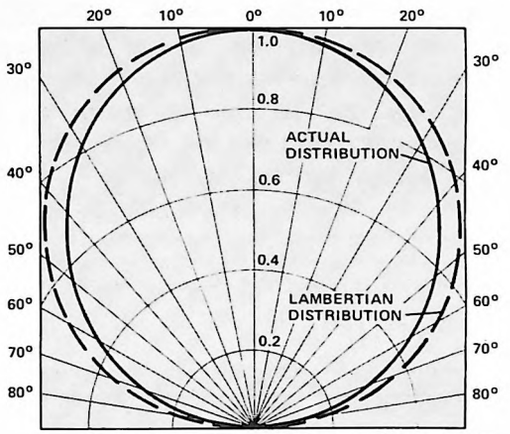


Figure 1. Normalized Angular Distribution of Luminous Intensity.

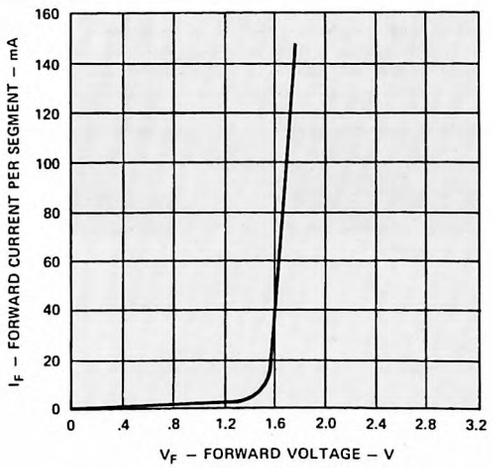


Figure 2. Forward Current versus Forward Voltage.

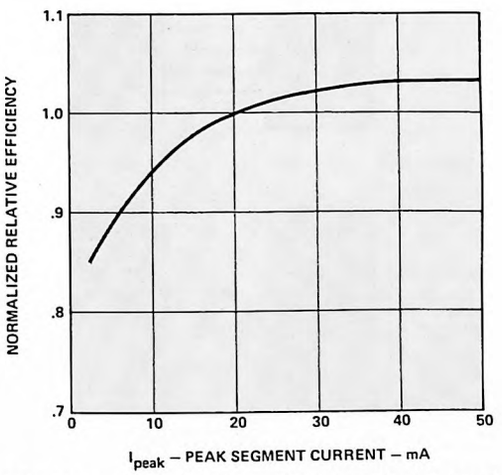


Figure 3. Normalized Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

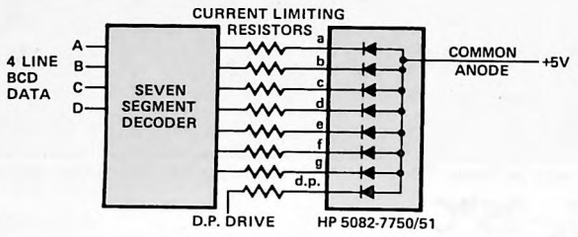


Figure 4. Direct Drive Circuit for the 5082-7750/51 Common Anode Display.

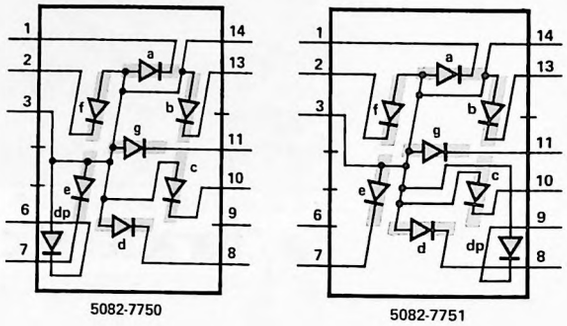


Figure 5. Internal Circuit Diagram.

Electrical

The common anode 5082-7750 series devices are arrays of eight discrete light emitting diodes, which are optically magnified to form seven individual segments plus a decimal point. As depicted in Figure 4, character encoding on the 7750 and the 7751 can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of strobing techniques, only one decoder/driver is required to drive a display containing up to 16 characters as outlined in Figure 6. When each character in the display is illuminated in sequence, at a minimum of 100 times per second, flicker-free characters are formed. Under average current drive conditions of 12.5mA/segment the display is readable to distances of 20 feet and will retain good contrast under most high ambient lighting conditions.

Mechanical

The 5082-7750 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 500 mil centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame has an integral seating plane which will hold the package approximately .035" above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only Freon TF, Freon TE, (for Freons, up to 2 min. max. at boiling temp.), Isoproponal, or water be used for cleaning operations. To improve "ON" segment contrast, the entire front surface of the display, except for emitting areas, is finished in a uniform black color. Additional filters, such as Plexiglas 2423, Panelgraphic 60 or 63, and Homalite 100-1600, may be incorporated to reduce the ambient reflectance and improve display contrast.

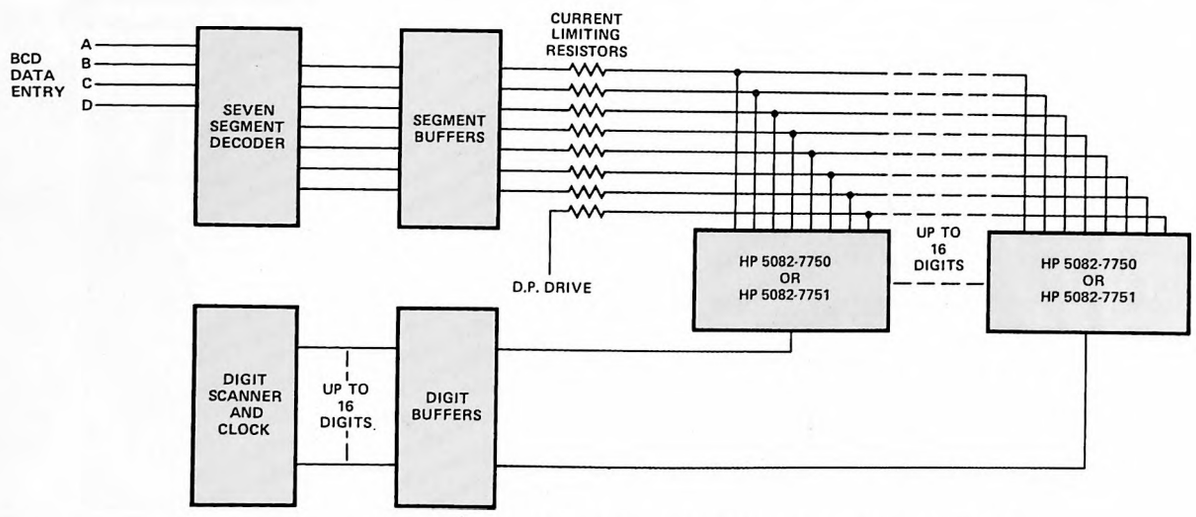


Figure 6. General Strobe Drive Scheme for Common Anode (5082-7750/51) Displays.

Polarity and Overflow Indicator—5082-7752

Absolute Maximum Ratings

Power Dissipation T_A = 25°C 250mW
Operating Temperature Range . . . . . -20°C to +85°C
Storage Temperature Range . . . . . -20°C to +85°C
Average Forward Current/Segment[1] T_A = 25°C 25mA
Peak Forward Current/Segment T_A = 25°C (Pulse Duration ≤500μs) 150mA
Reverse Voltage Segment a, b, or c 6V
Reverse Voltage Segment d 12V
Maximum Solder Temperature 1/16" Below Seating Plane (t≤5 sec)[2] . . . . . 230°C

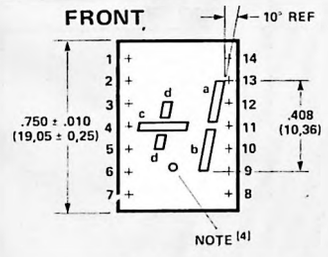
NOTES: 1. Derate from 25°C @ 0.25mA/°C per segment. 2. Clean only in Freon TE, Isopropanol, ethanol or water.

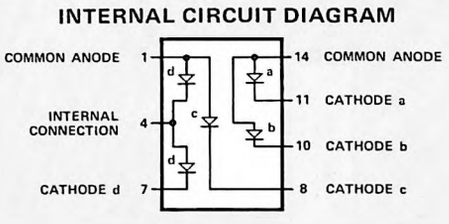
Electrical/Optical Characteristics at T_A=25°C

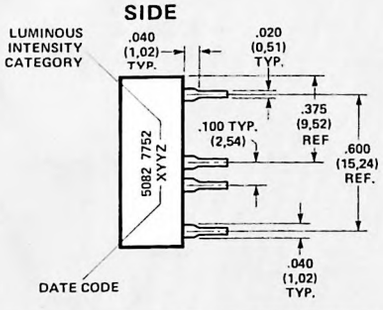
Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[1] (Digit Average)	I_v	I_{PEAK} = 100mA 12.5% Duty Cycle		350		μcd
		I_F = 20mA	150	400		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength[2]	λ_D			645		nm
Forward Voltage, Segments a, b or c	V_F	I_F = 20mA		1.6	2.0	V
Forward Voltage, Segments d	V_F	I_F = 20mA		3.2	4.0	V
Reverse Current, Segments a, b or c	I_R	V_R = 6V		10		μA
Reverse Current, Segments d	I_R	V_R = 12V		10		μA
Rise and Fall Time [3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage Segments a, b or c	$\Delta V_F/°C$			-2.0		mV/°C
Temperature Coefficient of Forward Voltage Segments d	$\Delta V_F/°C$			-4.0		mV/°C
Temperature Coefficient of Luminous Intensity	$\Delta I_v/°C$			-1.0		%/°C

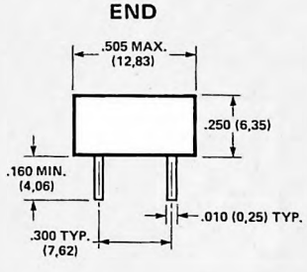
NOTES: 1. The digits are categorized for luminous intensity with the intensity categories designated by a letter located on the right hand side of the package. 2. Dominant wavelength, λ_D, is that wavelength which passes through the centroid of a photopically weighted spectral distribution. This wavelength defines the color perceived by the eye. 3. Time for a 10%-90% change of light intensity for step change in current.

Package Dimensions—5082-7752









PIN NO.	FUNCTION
1	Anode c, d
2	No Pin
3	No Pin
4	Internal Connection[3]
5	No Pin
6	No Pin
7	Cathode d
8	Cathode c
9	No Pin
10	Cathode b
11	Cathode a
12	No Pin
13	No Pin
14	Anode a, b

NOTES:
1. Dimensions in inches and (millimeters)
2. Tolerances on all dimensions are ± .015" (± 0,38) unless otherwise specified.
3. See Internal Circuit Diagram.
4. Unused dp position.

HEWLETT hp PACKARD

COMPONENTS

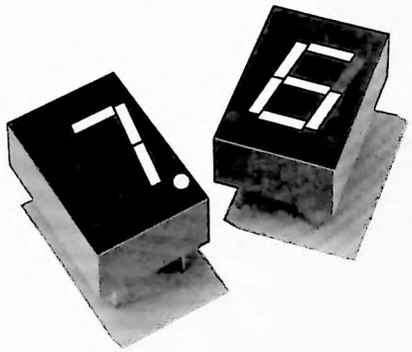
.43" SOLID STATE SEVEN SEGMENT INDICATOR

5082-7760

TECHNICAL DATA JANUARY 1975

Features

- 5082-7760
  - Common Cathode
  - Right Hand D.P.
- Large Digit
  - Viewing Up to 20 Feet
- Excellent Character Appearance
  - Continuous Uniform Segments
  - Wide Viewing Angle
  - High Contrast
- IC Compatible
  - 1.6V dc per Segment
- Standard 0.3" DIP Lead Configuration
  - PC Board or Standard Socket Mountable
- Categorized for Luminous Intensity
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category



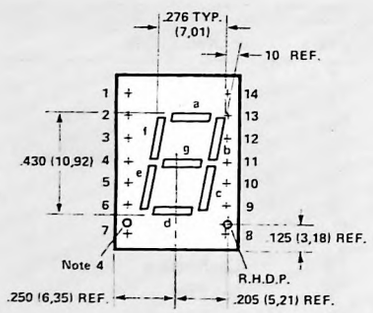
Description

The HP 5082-7760 devices are common cathode LED displays. This large .43" high character presents a bright, continuously uniform seven segment display. Designed for viewing distances of up to 20 feet, these single digit displays provide a high contrast ratio and a wide viewing angle.

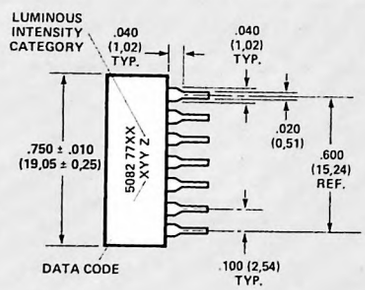
These 5082-7760 devices utilize a standard 0.3" dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Package Dimensions

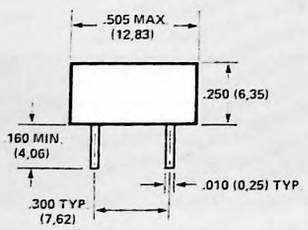
FRONT



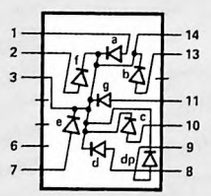
SIDE



END



INTERNAL CIRCUIT DIAGRAM



PIN	FUNCTION[5] 5082-7760
1	ANODE - a
2	ANODE -f
3	CATHODE[3]
4	NO PIN
5	NO PIN
6	NO CONN.[5]
7	ANODE - e
8	ANODE - d
9	ANODE - dp
10	ANODE - c
11	ANODE - g
12	NO PIN
13	ANODE - b
14	CATHODE[3]

NOTES:

1. Dimensions in inches and (millimeters).
2. Tolerances on all dimensions are ±.015" (±0,32) unless specified.
3. Redundant cathode.
4. Unused dp position.
5. See Internal Circuit Diagram.

Absolute Maximum Ratings

Power Dissipation T_A = 25°C	400 mW
Operating Temperature Range	−20°C to +85°C
Storage Temperature Range	−20°C to +85°C
Average Forward Current/Segment or Decimal Pt. T_A = 25°C [1]	25 mA
Peak Forward Current/Segment or Decimal Pt. T_A = 25°C (Pulse Duration ≤ 500 μs)	150 mA
Reverse Voltage/Segment or Decimal Pt.	6V
Max. Solder Temperature 1/16" Below Seating Plane (t ≤ 5 sec.) [2]	230°C

NOTES: 1. Derate from 25°C at 0.25 mA/°C per segment of D.P. 2. Clean only in Freon TE, Freon TF, Isopropanol, ethanol or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1]	I_v	I_{PEAK} = 60mA 16.7% Duty Cycle		260		μcd
(Digit Average)		I_F = 20mA	150	400		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_D			639		nm
Forward Voltage, any Segment or D.P.	V_F	I_F = 20mA		1.6	2.0	V
Reverse Current, any Segment or D.P.	I_R	V_R = 6V		10		μA
Rise and Fall Time [3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F/°C$			−2.0		mV/°C
Temperature Coefficient of Luminous Intensity	$\Delta I_v/°C$			−1.0		%/°C

NOTES:

1. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
2. The dominant wavelength, λ_D, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which is perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

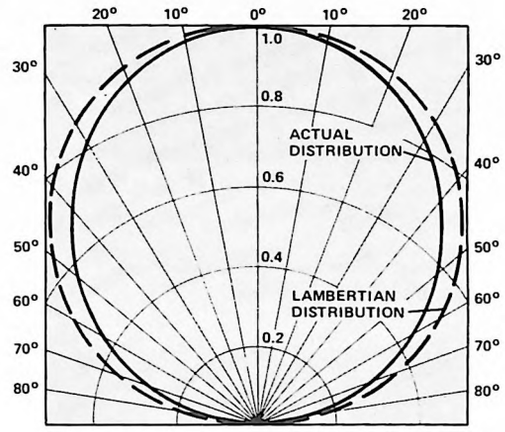


Figure 1. Normalized Angular Distribution of Luminous Intensity.

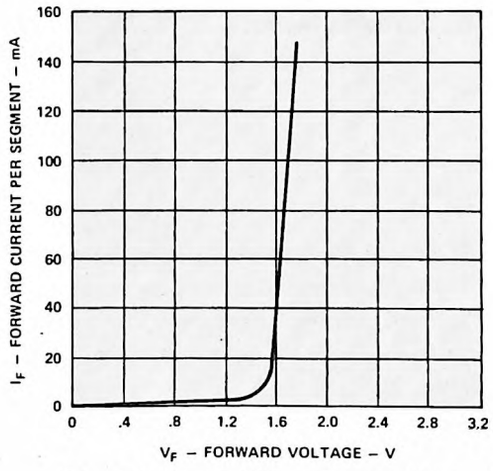


Figure 2. Forward Current versus Forward Voltage.

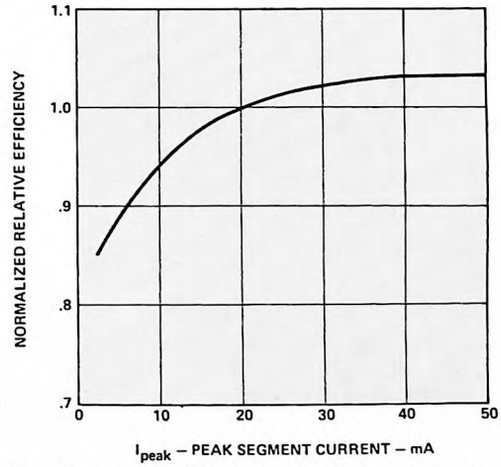


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

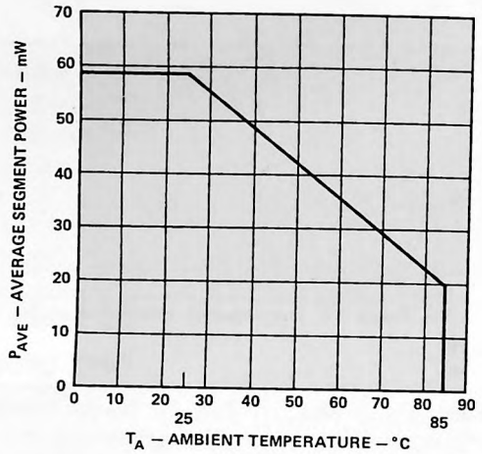


Figure 4. Allowable Segment Power Dissipation as a Function of Ambient Temperature.

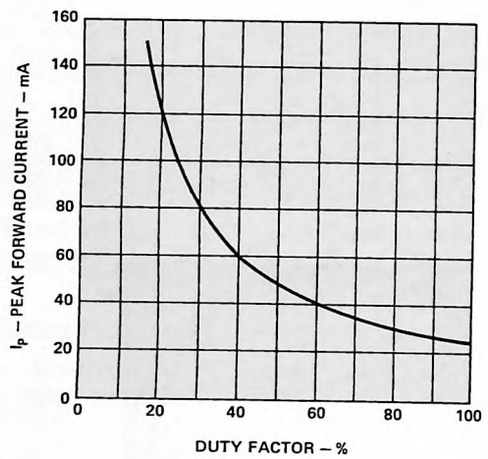


Figure 5. Maximum Peak Forward Current as a Function or Duty Factor.

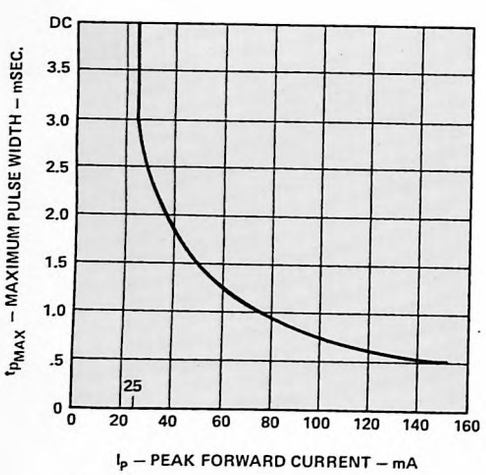


Figure 6. Maximum Allowable Pulse Width versus Peak Current.

Electrical

The 5082-7760 Display is composed of eight light emitting diodes in a common cathode connection and optically magnified to form seven individual segments and a right-hand decimal point.

The diodes are made of GaAsP (Gallium Arsenide Phosphide) junction on a GaAs substrate. Diode turn-on voltage is approximately 1.55 volts and typical forward diode resistance is 5 ohms. For strobing at peak currents a user should take this forward resistance into account in order to compute average power dissipation per segment.

$$P_{AVG}/\text{Segment} = I_{PEAK}\,[1.55V + 5\Omega \times I_{PEAK}] \times [\text{Duty Factor}]$$

This display may be operated at various peak currents with pulse width determined by Figure 6. Light output for a selected peak current may be calculated from the 20mA value using the following formula:

$$I_v = (I_{v\,20mA})\,K\,\left(\frac{I_{F\,AVG}}{20mA}\right)$$

Where: I_v = Luminous Intensity at desired I_{AVG}

I_{v20mA} = Luminous Intensity at I_F = 20mA

I_{AVG} = Average Forward Current per segment = (I_{PEAK} X Duty Factor)

K = Efficiency Factor at Peak Forward Current from Figure 3.

Under average current drive conditions of 10mA/segment the display is readable to distances of 20 feet and will retain good contrast under most high ambient lighting conditions.

Contrast Enhancement

The 5082-7760 Display may be effectively filtered using one of the following filter products: Homalite 100-1600; Panelgraphic Ruby Red 60 or Dark Red 63; Plexiglas 2423; 3M Brand Light Control Film for daylight viewing.

Mechanical

The 5082-7760 display is constructed using a lead frame forming a standard DIP package. Individual displays may be end stacked on .5 inch (12.7mm) minimum centers. The lead frame seating plane will hold a display package approximately .035 inch (.89mm) above a PC board.

The following solvents are recommended for flux removal: Freon TF and Freon TE (up to 2 minutes in freon vapors at boiling temperature); Isopropanol, Ethonal and water.

HEWLETT hp PACKARD

COMPONENTS

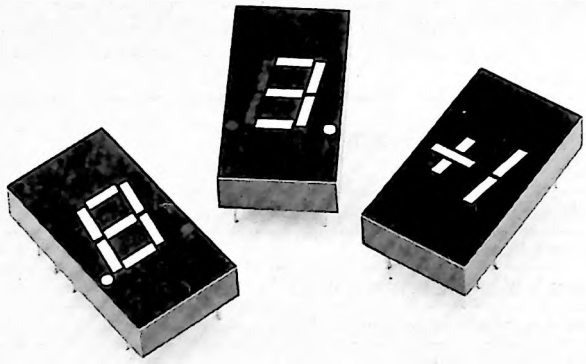
0.3" SOLID STATE SEVEN SEGMENT INDICATORS

5082-7730 SERIES

TECHNICAL DATA JANUARY 1975

Features

- 5082-7730
  - Common Anode
  - Left Hand D.P.
- 5082-7731
  - Common Anode
  - Right Hand D.P.
- 5082-7732
  - Common Anode
  - Polarity and Overflow Indicator
- Excellent Character Appearance
  - Continuous Uniform Segments
  - Wide Viewing Angle
  - High Contrast
- IC Compatible
  - 1.6V dc per Segment
- Standard 0.3" DIP Lead Configuration
  - PC Board or Standard Socket Mountable
- Categorized for Luminous Intensity
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category

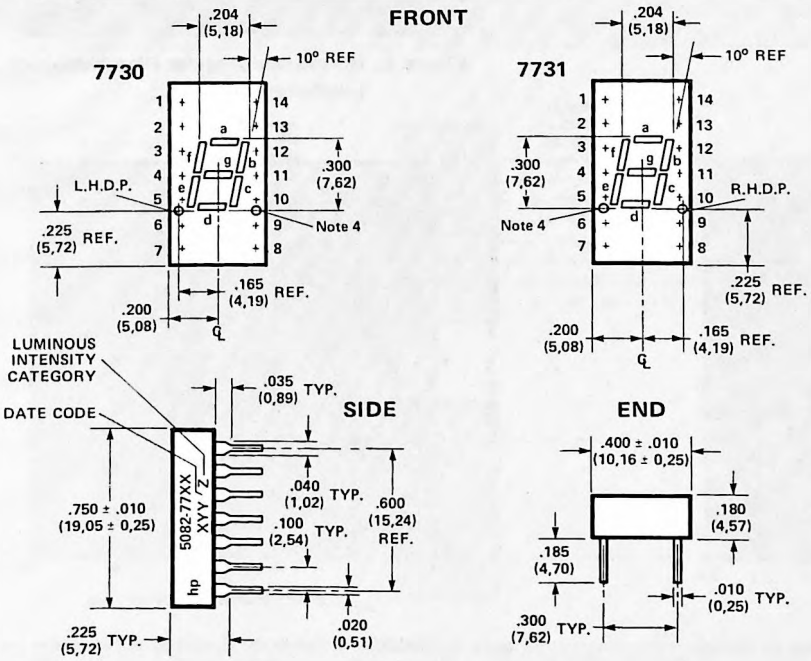


Description

The HP 5082-7730 series devices are common anode LED displays. The series includes a left hand and a right hand decimal point numeric display as well as a polarity and overflow indicator. The large 0.3" high character size generates a bright, continuously uniform seven segment display. Designed for viewing distances of up to 10 feet, these single digit displays provide a high contrast ratio and a wide viewing angle.

The 5082-7730 series devices utilize a standard 0.3" dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Package Dimensions



PIN	FUNCTION [5]	
	5082-7730	5082-7731
1	CATHODE - a	CATHODE - a
2	CATHODE - f	CATHODE - f
3	ANODE [3]	ANODE [3]
4	NO PIN	NO PIN
5	NO PIN	NO PIN
6	CATHODE - dp	NO CONN.
7	CATHODE - e	CATHODE - e
8	CATHODE - d	CATHODE - d
9	NO CONN.	CATHODE - dp
10	CATHODE - c	CATHODE - c
11	CATHODE - g	CATHODE - g
12	NO PIN	NO PIN
13	CATHODE - b	CATHODE - b
14	ANODE [3]	ANODE [3]

NOTES:
1. Dimensions in inches and (millimeters).
2. Tolerances on all dimensions are ±.015" (±0,38) unless otherwise specified.
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram.

Absolute Maximum Ratings

Power Dissipation T_A = 25°C	400 mW
Operating Temperature Range	−20°C to + 85°C
Storage Temperature Range	−20°C to + 85°C
Average Forward Current/Segment or Decimal Pt. T_A = 25°C [1]	25 mA
Peak Forward Current/Segment or Decimal Pt. T_A = 25°C (Pulse Duration ≤ 500 μs)	150 mA
Reverse Voltage/Segment or Decimal Pt.	6V
Max. Solder Temperature 1/16" Below Seating Plane (t ≤ 5 sec.) [2]	230°C

NOTES: 1. Derate from 25°C at 25 mA/°C per segment or D.P. 2. Clean only in Freon TE, Freon TF, Isopropanol, or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1] (Digit Average)	I_v	I_{PEAK} = 100mA 10% Duty Cycle	150	200		μcd
		I_F = 20mA DC		350		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_d			639		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 100mA		1.6	2.0	V
Reverse Current/Segment or D.P.	I_R	V_R = 6V		10		μA
Rise and Fall Time [3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F/°C$			-2.0		mV/°C
Temperature Coefficient of Luminous Intensity	$\Delta I_v/°C$			-1.0		%/°C

NOTES:

1. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
2. Dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity diagram and represents that single wavelength which is perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

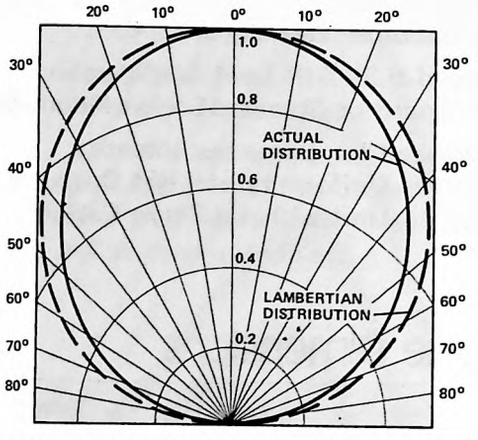


Figure 1. Normalized Angular Distribution of Luminous Intensity.

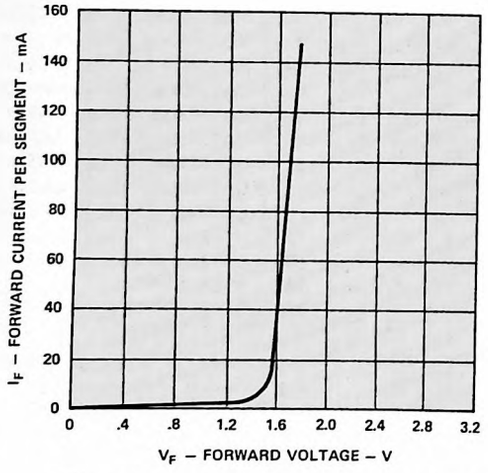


Figure 2. Forward Current versus Forward Voltage.

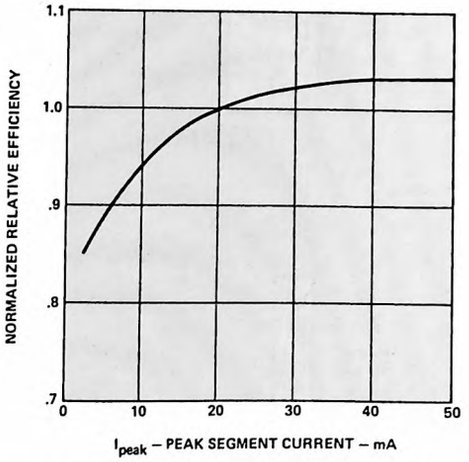


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

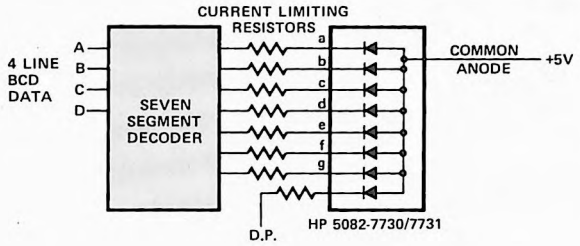


Figure 4. Direct Drive Circuit for the 5082-7730/7731 Common Anode Display.

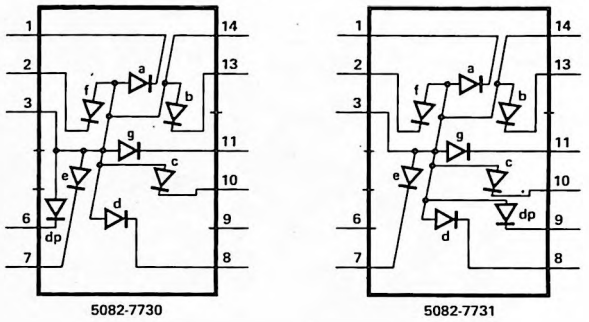


Figure 5. Internal Circuit Diagram.

The common anode 5082-7730 series devices are arrays of eight discrete light emitting diodes, which are optically magnified to form seven individual segments plus a decimal point. As depicted in Figure 4, character encoding on the 7730 and the 7731 can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of strobing techniques, only one decoder/driver is required to drive a display containing up to 16 characters as outlined in Figure 6. When each character in the display is illuminated in sequence, at a minimum of 100 times per second, flicker-free characters are formed. Under average current drive conditions of 10mA/segment, the display is easily readable to distances of ten feet and will retain good contrast under relatively high ambient lighting conditions.

The 5082-7730 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed at 400 mil centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame has an integral seating plane which will hold the package approximately .035" above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only Freon TF, Freon TE, Freon TE-35, Isoproponal, or water be used for cleaning operations. To improve display contrast, the entire front surface of the display, except for emitting areas, is finished in a uniform flat black. An additional filter, such as Plexiglas 2423 may be incorporated, if desired, to further lower the ambient reflectance and improve display contrast.

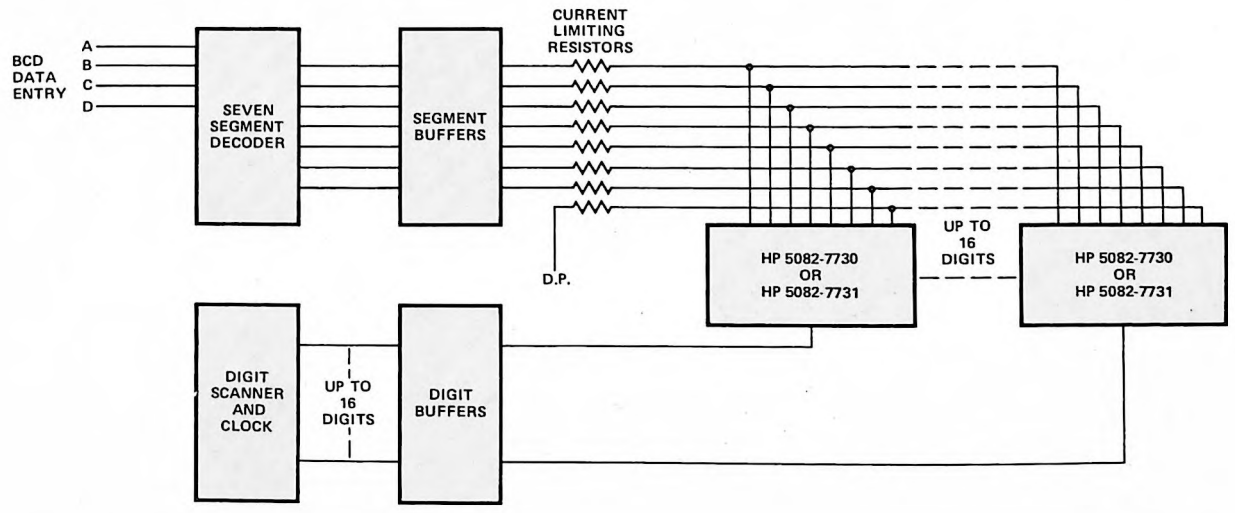


Figure 6. General Strobe Drive Scheme for Common Anode (5082-7730/7731) Displays.

Polarity and Overflow Indicator—5082-7732

ABSOLUTE MAXIMUM RATINGS

Power Dissipation T_A = 25°C	300 mW
Operating Temperature Range	−20°C to +85°C
Storage Temperature Range	−20°C to +85°C
Average Forward Current/Segment or Decimal Point [1] T_A = 25°C	25 mA
Peak Forward Current/Segment or Decimal Point T_A = 25°C (Pulse Duration ≤ 500 μs)	150 mA
Reverse Voltage Segment or Decimal Point	6V
Reverse Voltage Segment a-b or d	12V
Maximum Solder Temperature 1/16" Below Seating Plane (t ≤ 5 sec) [2]	230°C

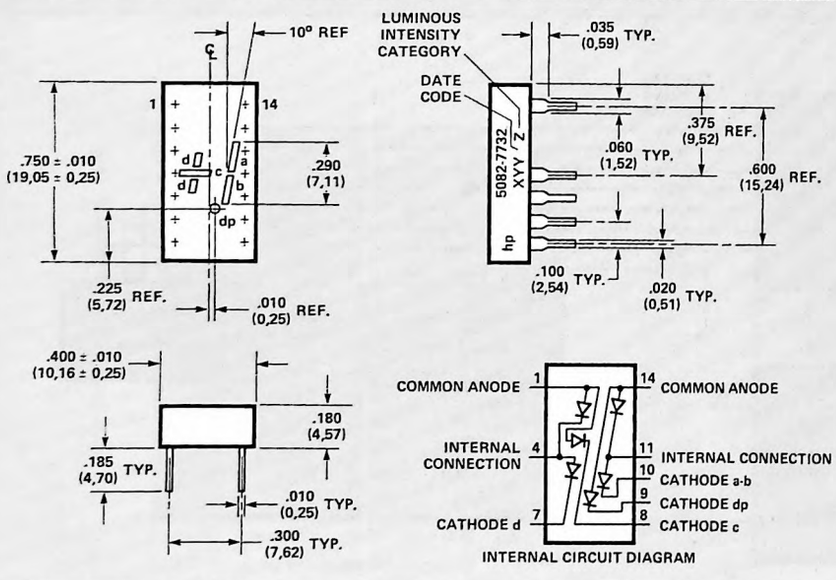
NOTES: 1. Derate from 25°C @ 0.25 mA/°C per segment or decimal point.
2. Clean only in Freon TF, Isopropanol or water.

ELECTRICAL/OPTICAL CHARACTERISTICS AT 25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1]	$I_{v\ AVE.}$	I_{PEAK} = 100 mA 12.5% Duty Cycle		200		μcd
		I_F = 20 mA	100	350		
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage, Segments a-b or d	V_F	I_F = 20 mA		3.2	4.0	V
Forward Voltage, Segments c or dp	V_F	I_F = 20 mA		1.6	2.0	V
Reverse Current, Segments a-b or d	I_R	V_R = 12V		10		μA
Reverse Current, Segments c or dp	I_R	V_R = 6V		10		μA
Rise and Fall Time [2]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage Segments a-b or d	ΔV_F /°C			−4.0		mV/°C
Temperature Coefficient of Forward Voltage Segments c or dp	ΔV_F /°C			−2.0		mV/°C
Temperature Coefficient of Luminous Intensity	ΔI_v/°C			−1.0		%/°C

NOTES: 1. The digits are categorized for luminous intensity with the intensity categories designated by a letter located on the right hand side of the package.
2. Time for a 10%-90% change of light intensity for step change in current.

PACKAGE DIMENSIONS — 5082-7732



PIN NO.	FUNCTION
1	Anode c, d
2	No Pin
3	No Pin
4	Internal Connection [3]
5	No Pin
6	No Pin
7	Cathode d
8	Cathode c
9	Cathode dp
10	Cathode a-b
11	Internal Connection [3]
12	No Pin
13	No Pin
14	Anode a-b, dp

NOTES:
1. Dimensions in inches and (millimeters)
2. Tolerances on all dimensions are ± .015" (± 0,38) unless otherwise specified.
3. See Internal Circuit Diagram.

HEWLETT hp PACKARD

COMPONENTS

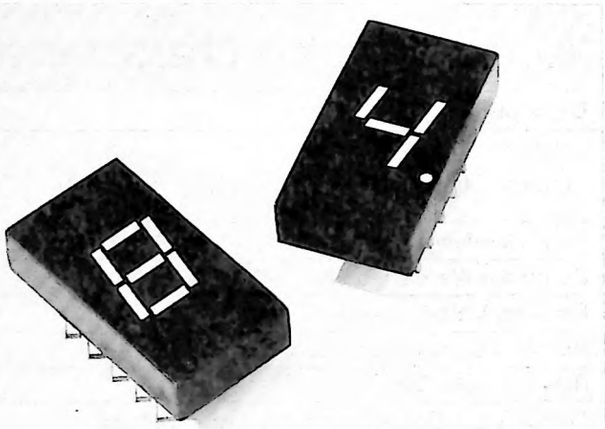
0.3" SOLID STATE SEVEN SEGMENT INDICATOR

5082-7740

TECHNICAL DATA JANUARY 1975

Features

- COMMON CATHODE
- RIGHT HAND DP
- EXCELLENT CHARACTER APPEARANCE
  - Continuous Uniform Segments
  - Wide Viewing Angle
  - High Contrast
- IC COMPATIBLE
  - 1.6V per Segment
- STANDARD 0.3" DIP LEAD CONFIGURATION
  - PC Board or Standard Socket Mountable
- CATEGORIZED FOR LUMINOUS INTENSITY
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category

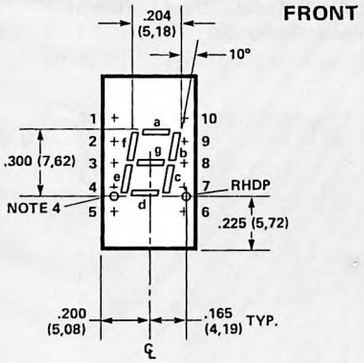


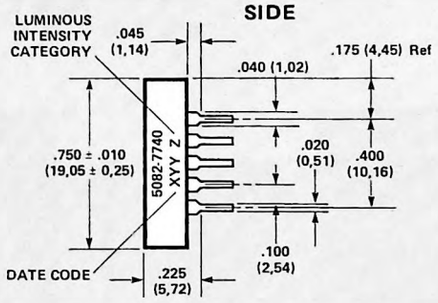
Description

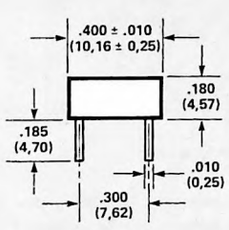
The HP 5082-7740 is a common cathode LED numeric display with a right hand decimal point. The large 0.3" high character size generates a bright, continuously uniform 7 segment display. Designed for viewing distances of up to 10 feet, this single digit display has been human engineered to provide a high contrast ratio and wide viewing angle.

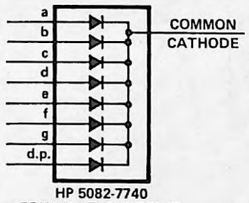
The 5082-7740 utilizes a standard 0.3" dual-in-line package configuration that allows for quick mounting on PC boards or in standard IC sockets. Requiring a forward voltage of only 1.6V, the display is inherently IC compatible allowing for easy integration into electronic calculators, credit card verifiers, TVs, radios, and digital clocks.

Package Dimensions









HP 5082-7740 EQUIVALENT CIRCUIT

PIN	FUNCTION 5082-7740
1	CATHODE[3]
2	ANODE - f
3	ANODE - g
4	ANODE - e
5	ANODE - d
6	CATHODE[3]
7	ANODE - dp
8	ANODE - c
9	ANODE - b
10	ANODE - a

NOTES:
1. Dimensions in inches and (millimeters)
2. Tolerances on all dimensions are ± .015" (± 0,38) unless otherwise specified.
3. Redundant cathodes.
4. LHDP not electrically connected.

Absolute Maximum Ratings

Power Dissipation T_A = 25°C	400 mW
Operating Temperature Range	−20°C to + 85°C
Storage Temperature Range	−20°C to + 85°C
Average Forward Current/Segment or Decimal Pt. T_A = 25°C [1]	25 mA
Peak Forward Current/Segment or Decimal Pt. T_A = 25°C (Pulse Duration ≤ 500 μs)	150 mA
Reverse Voltage/Segment or Decimal Pt.	6V
Max. Solder Temperature 1/16" Below Seating Plane (t ≤ 5 sec.) [2]	230°C

NOTES: 1. Derate from 25°C at .25 mA/°C per segment or D.P. 2. Clean only in Freon TF, Isopropanol, or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[1]	I_v AVE	I_{PEAK} = 100mA 10% Duty Cycle	50	150		μcd
		I_F = 20mA DC		350		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength[2]	λ_d			639		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 100mA		1.6	2.3	V
Reverse Current/Segment or D.P.	I_R	V_R = 6V		10		μA
Rise and Fall Time[3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F/°C$			-2.0		mV/°C
Temperature Coefficient of Luminous Intensity	$\Delta I_v/°C$			-1.0		%/°C

NOTES:

1. The digits are categorized for luminous intensity such that the variation from digit to digit within a category is not discernible to the eye. Intensity categories are designated by a letter located on the right hand side of the package.
2. Dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity diagram and represents that single wavelength which is perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

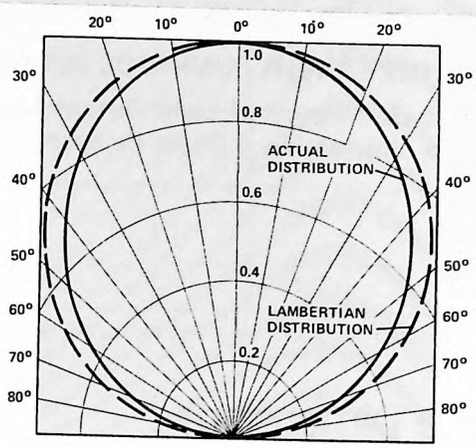


Figure 1. Normalized Angular Distribution of Luminous Intensity.

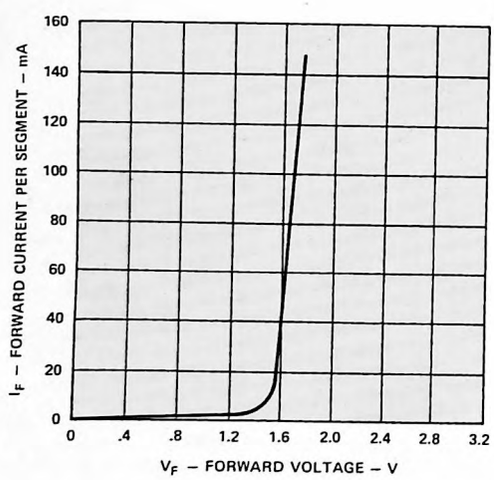


Figure 2. Forward Current versus Forward Voltage.

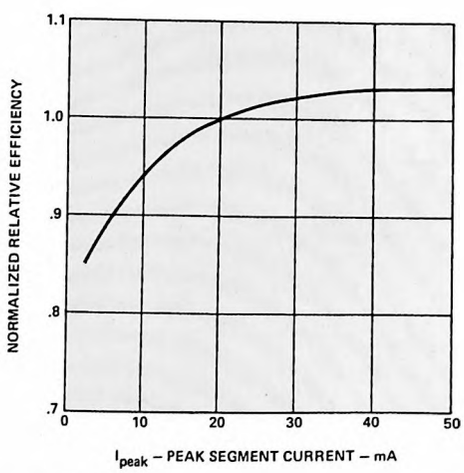


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

HEWLETT hp PACKARD

COMPONENTS

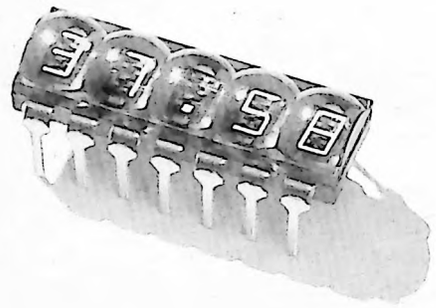
SOLID STATE NUMERIC INDICATOR (7 Segment Monolithic)

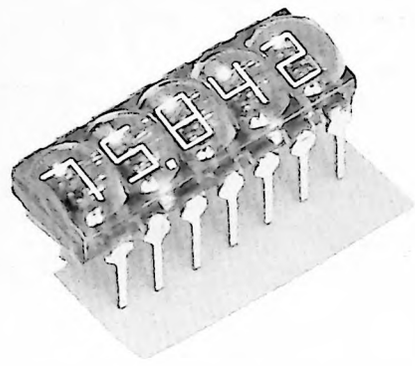
5082-7400 SERIES

TENTATIVE DATA DEC. 1973

Features

- **Ultra Low Power**
  - **Excellent Readibility at Only 1 mW per Segment**
- **Constructed for Stobed Operation**
  - **Minimizes Lead Connections**
- **Standard DIP Package**
  - **End Stackable**
  - **Integral Red Contrast Filter**
  - **Rugged Construction**
- **Categorized for Luminous Intensity**
  - **Assures Uniformity of Light Output from Unit to Unit within a Single Category**
- **IC Compatible**





Description

The HP 5082-7400 series are .11 inch high, seven segment GaAsP numeric indicators packaged in 3, 4, and 5 digit end-stackable clusters. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. Options include either the standard lower right hand decimal point or a centered decimal point for increased legibility in multi-cluster applications.

Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.

Device Selection Guide

Digits per Cluster	Configuration: Device		Part Number: Center Decimal Point	Part Number: Right Decimal Point
3 (right)			5082-7402	5082-7412
3 (left)			5082-7403	5082-7413
4			5082-7404	5082-7414
5			5082-7405	5082-7415

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment (Duration < 1 msec)	I_{PEAK}		110	mA
Average Current per Segment	I_{AVG}		5	mA
Power Dissipation per Digit [1]	P_D		80	mW
Operating Temperature, Ambient	T_A	–40	75	°C
Storage Temperature	T_S	–40	100	°C
Reverse Voltage	V_R		5	V

Note 1: At 25°C; derate 1 mW/°C above 25°C ambient.

Electrical /Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [2] (Time Averaged)	I_v	I_{AVG} = 1mA (I_{PK} = 10mA duty cycle = 10%)	5	20		µcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	I_F = 10mA		1.6	2.0	V
Reverse Current/Segment or dp	I_R	V_R = 5V			100	µA
Rise and Fall Time [3]	t_r, t_f			10		ns

Notes: 2. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 3. Time for a 10%-90% change of light intensity for step change in current.

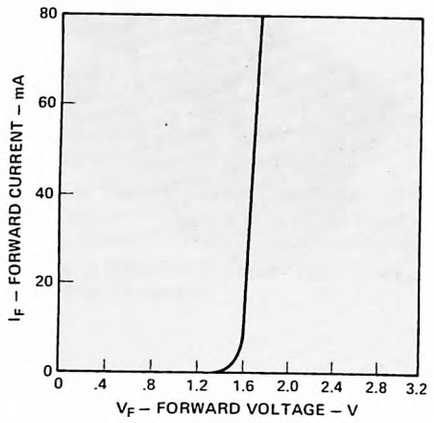


Figure 1. Forward Current vs. Forward Voltage.

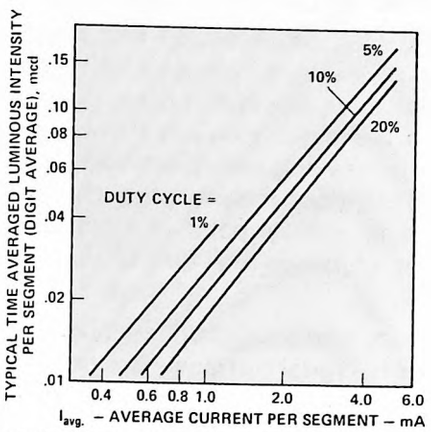


Figure 2. Typical Time Averaged Luminous Intensity per Segment (Digit Average) vs. Average Current per Segment.

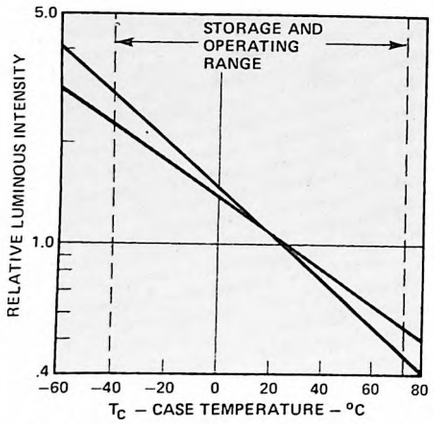


Figure 3. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

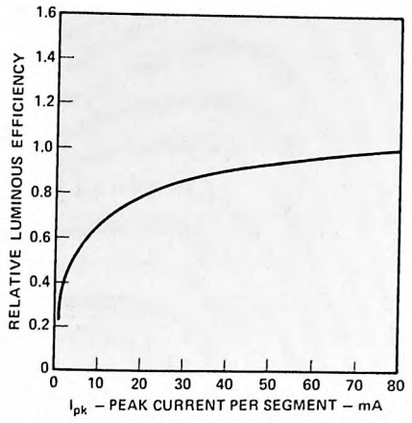


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment.

Package Description

Note 1. Dimensions in inches and (millimeters)
Note 2. Tolerances on all dimensions are ±.015 (0,038) unless otherwise noted.

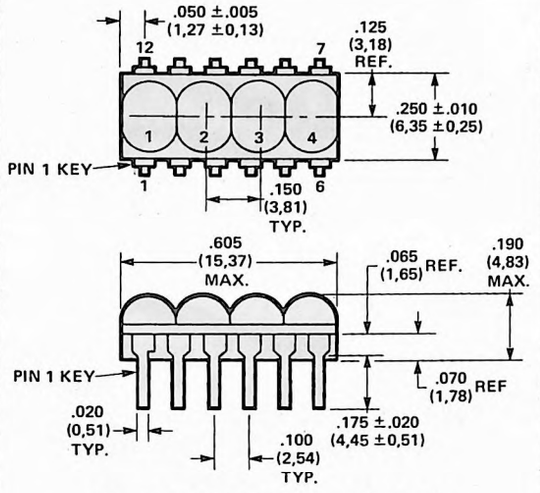


Figure 5. 5082-7402/-7403/-7404/ -7412/-7413/-7414

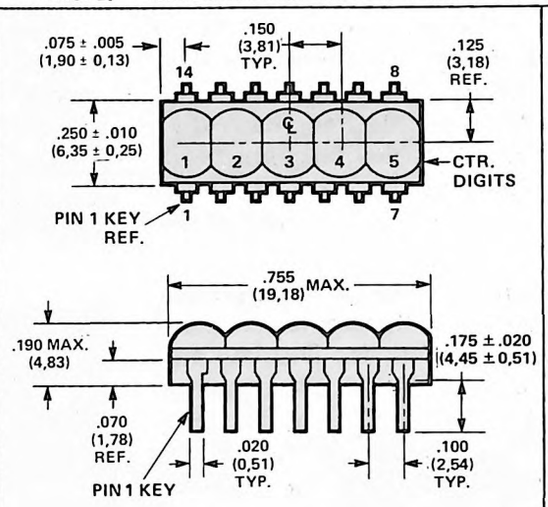
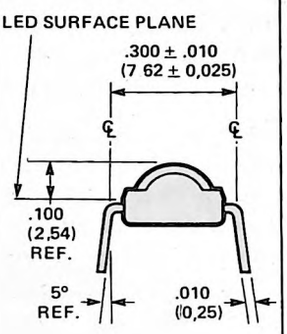


Figure 6. 5082-7405/7415



All Devices

Magnified Character Font Description

DEVICES

5082-7402
5082-7403
5082-7404
5082-7405

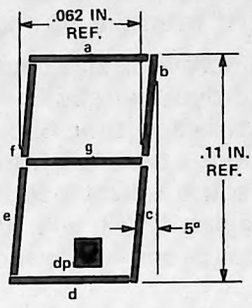


Figure 7. Center Decimal Point Configuration.

DEVICES

5082-7412
5082-7413
5082-7414
5082-7415

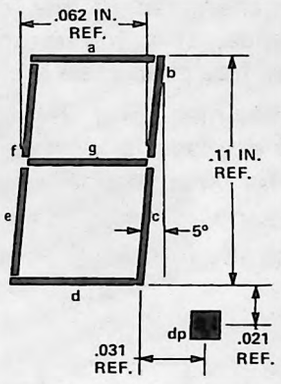


Figure 8. Right Decimal Point Configuration

Device Pin Description

PIN NO.	5082-7402/7412 FUNCTION	5082-7403/7413 FUNCTION	5082-7404/7414 FUNCTION	5082-7405/7415 FUNCTION
1	N/C	CATHODE 1	CATHODE 1	CATHODE 1
2	ANODE e	ANODE e	ANODE e	ANODE e
3	ANODE c	ANODE c	ANODE c	ANODE c
4	CATHODE 3	CATHODE 3	CATHODE 3	CATHODE 3
5	ANODE dp	ANODE dp	ANODE dp	ANODE dp
6	CATHODE 4	N/C	CATHODE 4	ANODE d
7	ANODE g	ANODE g	ANODE g	CATHODE 5
8	ANODE d	ANODE d	ANODE d	ANODE g
9	ANODE f	ANODE f	ANODE f	CATHODE 4
10	CATHODE 2	CATHODE 2	CATHODE 2	ANODE f
11	ANODE b	ANODE b	ANODE b	(See Note 1)
12	ANODE a.	ANODE a	ANODE a	ANODE b
13	–	–	–	CATHODE 2
14	–	–	–	ANODE a

Note 1. Leave Pin 11 unconnected.

Electrical

Character encoding can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of a strobing technique, only one decoder/driver is required for each display. In addition, the number of interconnection lines between the display and the drive circuitry is minimized to 8 + N, where N is the number of characters in the display.

Each of the segments on the display is "addressable" on two sets of lines – the "character enable" lines and the "segment enable" lines. Displays are wired so that all of the cathodes of all segments comprising one character are wired together to a single character enable line. Similarly, the anodes of each of like segments (e.g., all of the decimal points, all of the center line anodes, etc.) are wired to a single line. Therefore, a single digit in the cluster can be illuminated by connecting the appropriate character enable line, with the appropriate segment enable lines for the character being displayed. When each character in the display is illuminated in sequence, at a minimum of 100 times a second, flicker free characters are formed.

The decimal point in the 7412, 7413, 7414, and 7415 displays is located at the lower right of the digit for conventional driving schemes.

The 7402, 7403, 7404 and 7405 displays contain a centrally located decimal point which is activated in place of a digit. In long registers, this technique of setting off the decimal point significantly improves the display's readability. With respect to timing, the decimal point is treated as a separate character with its own unique time frame.

A detailed discussion of display circuits and drive techniques appears in Application Note 937.

Mechanical

The 5082-7400 series package is a standard 12 or 14 Pin DIP consisting of a plastic encapsulated lead frame with integral molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. The lead frame construction allows use of standard DIP insertion tools and techniques. Alignment problems are simplified due to the clustering of digits in a single package. The shoulders of the lead frame pins are intentionally raised above the bottom of the package to allow tilt mounting of up to 20° from the PC board.

To improve display contrast, the plastic incorporates a red dye that absorbs strongly at all visible wavelengths except the 655 nm emitted by the LED. In addition, the lead frames are selectively darkened to reduce reflectance. An additional filter, such as Plexiglass 2423, will further lower the ambient reflectance and improve display contrast.

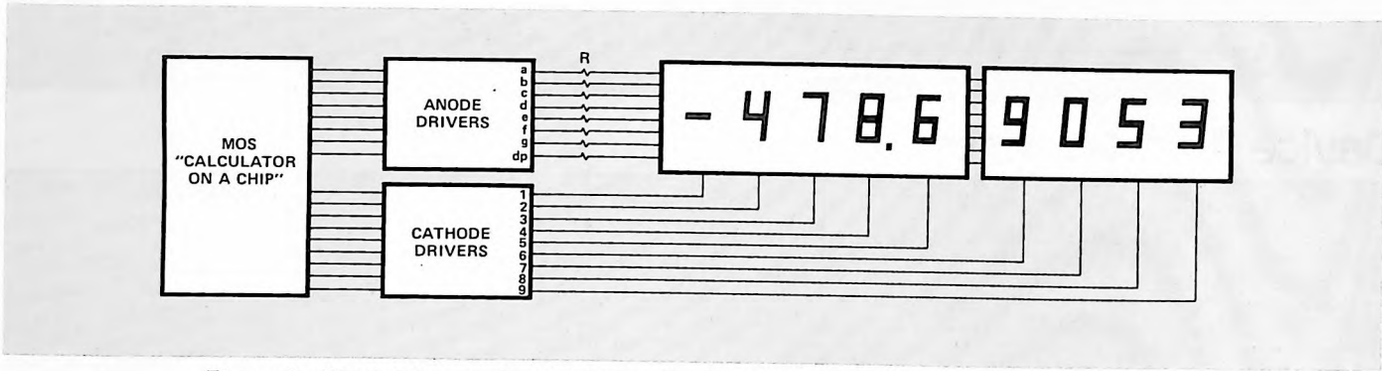


Figure 9. Block Diagram for Calculator Display Using Lower Right Hand Decimal Point.

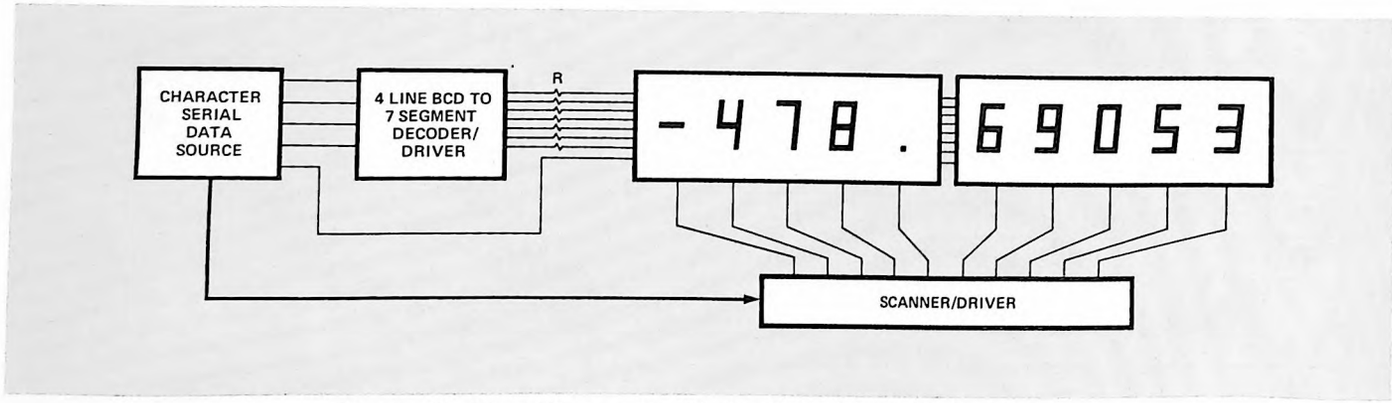


Figure 10. Block Diagram for Display Using Center Decimal Point.

HEWLETT hp PACKARD

COMPONENTS

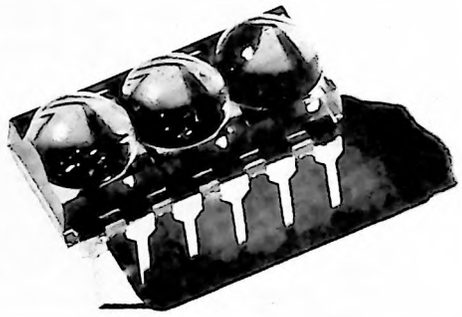
SOLID STATE NUMERIC INDICATOR (7 Segment Monolithic)

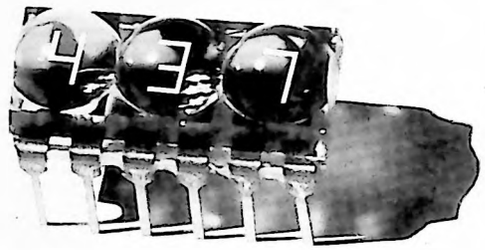
5082-7430 SERIES

TENTATIVE DATA OCT. 1973

Features

- MOS COMPATIBLE
  - Can be Driven Directly from many MOS Circuits
- LOW POWER
  - Excellent Readability at Only 0.5mW per Segment
- CONSTRUCTED FOR STROBED OPERATION
  - Minimizes Lead Connections
- STANDARD DIP PACKAGE
  - End Stackable
  - Integral Red Contrast Filter
  - Rugged Construction
- CATEGORIZED FOR LUMINOUS INTENSITY
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category



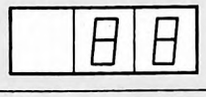
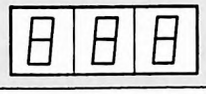


Description

The HP 5082-7430 series displays are .11 inch high, seven segment GaAsP numeric indicators packaged in 2 and 3 digit end-stackable clusters on 200 mil centers. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. These clusters have the standard lower right hand decimal points.

Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.

Device Selection Guide

Digits per Cluster	Configuration		Part Number
	Device	Package	
2(right)		(Figure 5)	5082-7432
3		(Figure 5)	5082-7433

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500μs)	I_{PEAK}		50	mA
Average Current per Segment or dp	I_{AVG}		5	mA
Power Dissipation per Digit [1]	P_D		80	mW
Operating Temperature, Ambient	T_A	–40	75	°C
Storage Temperature	T_S	–40	100	°C
Reverse Voltage	V_R		5	V
Solder Temperature 1/16" below seating plane (t ≤ 5 sec.) [2]			230	°C

NOTES: 1. Derate linearly @ 1 mW/°C above 25°C ambient. 2. See Mechanical section for recommended flux removal solvents.

Electrical/Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [3]	I_v	I_{AVG} = 500μA (I_{PK} = 5mA duty cycle = 10%)	10	40		μcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	I_F = 5mA		1.55	2.0	V
Reverse Current/Segment or dp	I_R	V_R = 5V			100	μA
Rise and Fall Time [4]	t_r, t_f			10		ns

NOTES: 3. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 4. Time for a 10%-90% change of light intensity for step change in current.

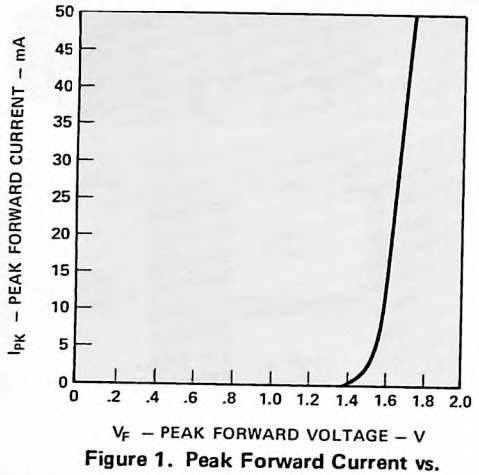


Figure 1. Peak Forward Current vs. Peak Forward Voltage

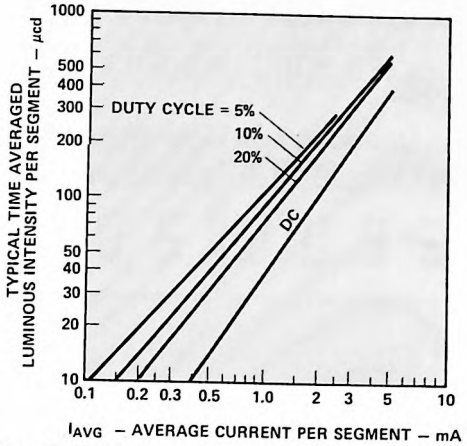


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

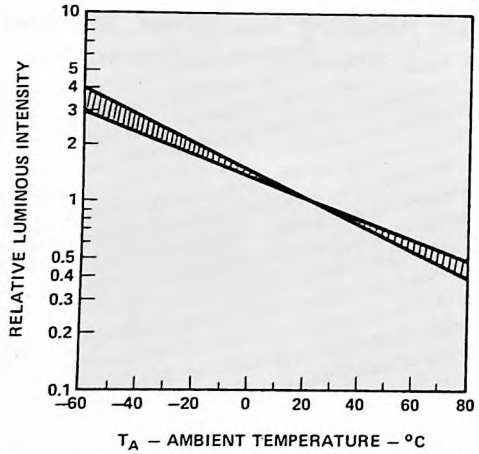


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

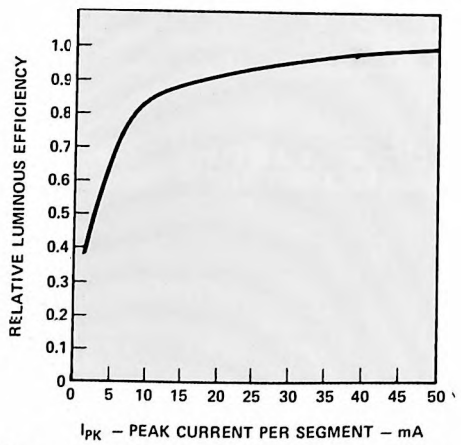


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

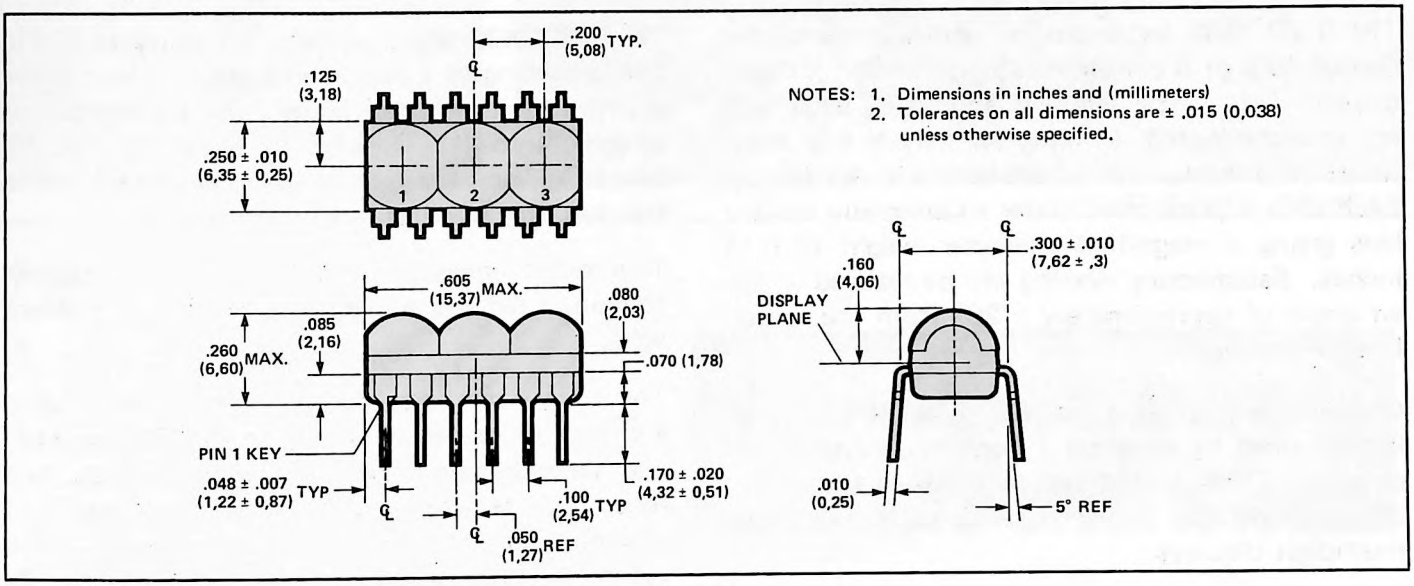


Figure 5.

Magnified Character Font Description

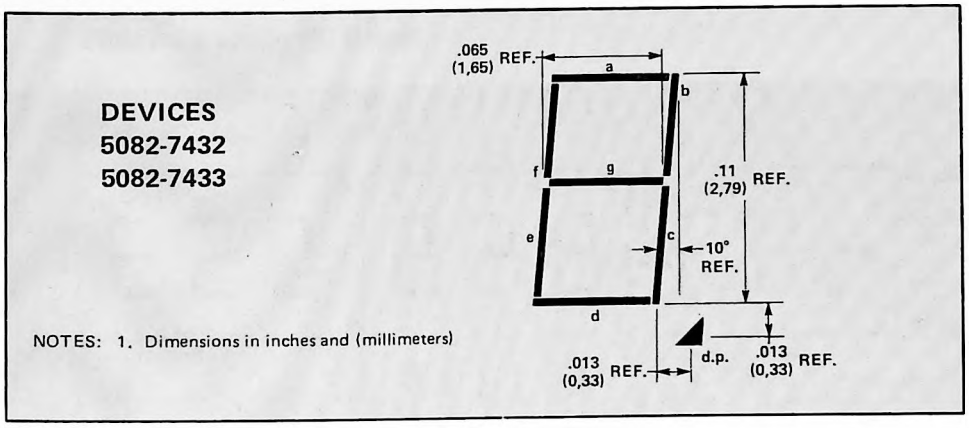


Figure 6.

Device Pin Description

PIN NUMBER	5082-7432 FUNCTION	5082-7433 FUNCTION
1	N/C	CATHODE 1
2	ANODE e	ANODE e
3	ANODE d	ANODE d
4	CATHODE 2	CATHODE 2
5	ANODE c	ANODE c
6	ANODE dp	ANODE dp
7	CATHODE 3	CATHODE 3
8	ANODE b	ANODE b
9	ANODE g	ANODE g
10	ANODE a	ANODE a
11	ANODE f	ANODE f
12	N/C	N/C

Electrical/Optical

The 5082-7430 series devices utilize a monolithic GaAsP chip of 8 common cathode devices for each display digit. The segment anodes of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under an integrally molded lens giving a magnified character height of 0.11 inches. Satisfactory viewing will be realized within an angle of approximately ± 20° from the centerline of the digit.

Character encoding on the 5082-7430 series devices is performed by standard 7 segment decoder/driver circuits. Through the use of strobing techniques only one decoder/driver is required for very long multidigit displays.

A discussion of display circuits and drive techniques appears in Application Note 946.

Mechanical

The 5082-7430 series package is a standard 12 Pin DIP consisting of a plastic encapsulated lead frame with integrally molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. Alignment problems are simplified due to the clustering of digits in a single package.

To improve display contrast, the plastic encapsulant contains a red dye to reduce the reflected ambient light.

The devices can be soldered for up to 5 seconds at a maximum solder temperature of 230°C (1/16" below the seating plane). The plastic encapsulant used in these displays may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operations.

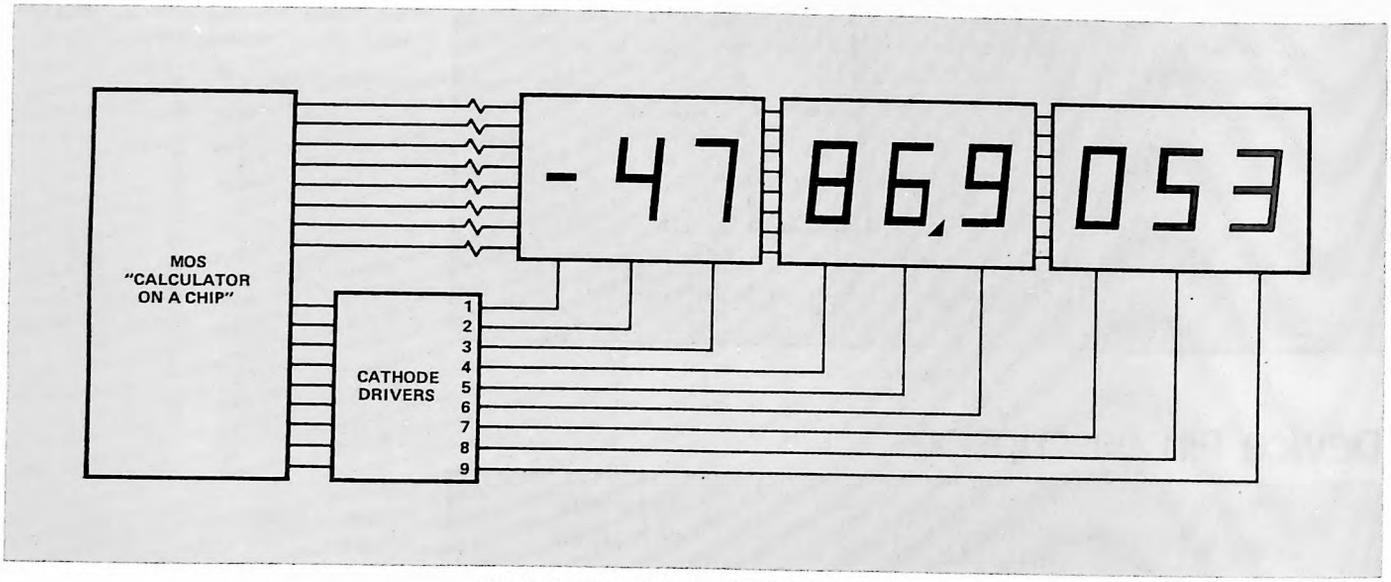


Figure 7. Block Diagram for Calculator Display

HEWLETT hp PACKARD

COMPONENTS

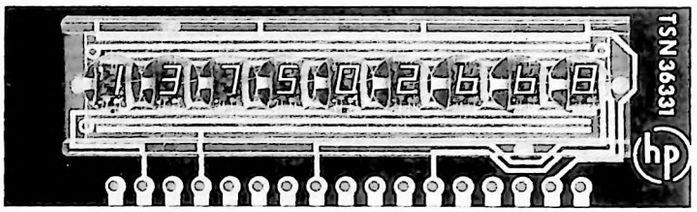
SPECIAL PARTS FOR CALCULATORS

5082-7440 SERIES

TENTATIVE DATA JANUARY 1975

Features

- MOS COMPATIBLE
  - Can be driven directly from MOS circuits.
- LOW POWER
  - Excellent readability at only 250μA average per segment.
- UNIFORM ALIGNMENT
  - Excellent alignment is assured by design.
- MATCHED BRIGHTNESS
  - Uniformity of light output from digit to digit on a single PC Board.
- AVAILABLE IN 2.0" (50,8) and 2.375" (60,325) BOARD LENGTHS



Description

The HP 5082-7440 series displays are .105" (2,67mm) high, seven segment GaAsP Numeric Indicators mounted in an eight or nine digit configuration on a P. C. Board. These special parts, designed specifically for calculators, have right hand decimal points and are mounted on 200 mil (5,08mm) centers. The plastic lens over the digits has a magnifier and a protective bezel built-in.

Applications are primarily portable, hand-held calculators and other products requiring low power, low cost and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Configuration		Part No.
	Device	Package	
8	8.8.8.8.8.8.8.8.	(Figure 5)	5082-7440
			5082-7448
9	8.8.8.8.8.8.8.8.8.	(Figure 5)	5082-7441
			5082-7449

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500μs)	I_{PEAK}		50	mA
Average Current per Segment or dp [1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	°C
Storage Temperature	T_S	-20	+85	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge (t ≤ 5 sec.) [2]			230	°C

NOTES: 1. Derate linearly @ 0.1mA/°C above 60°C ambient.

2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp	I_v	I_{AVG} = 500μA (I_{PK} = 5mA duty cycle = 10%)	9	40		μcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp [3]	V_F	I_F = 5mA		1.55		V

NOTES: 3. See Figure 7 for test circuit.

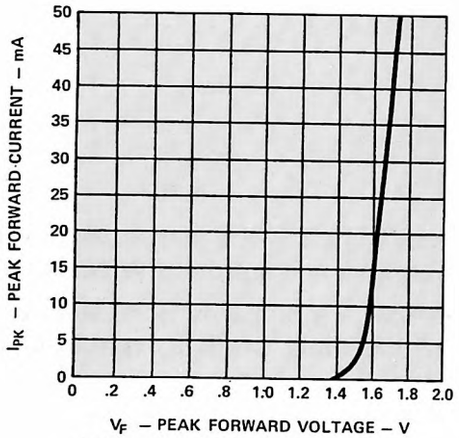


Figure 1. Peak Forward Current vs. Peak Forward Voltage

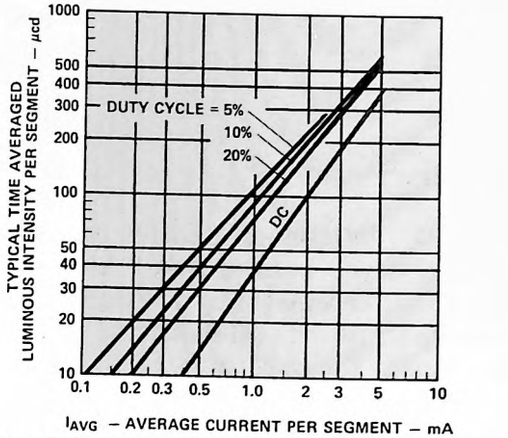


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

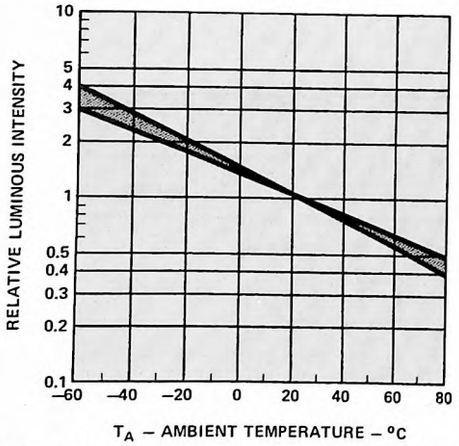


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

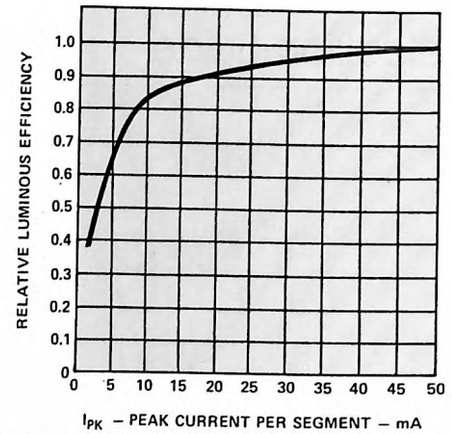


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

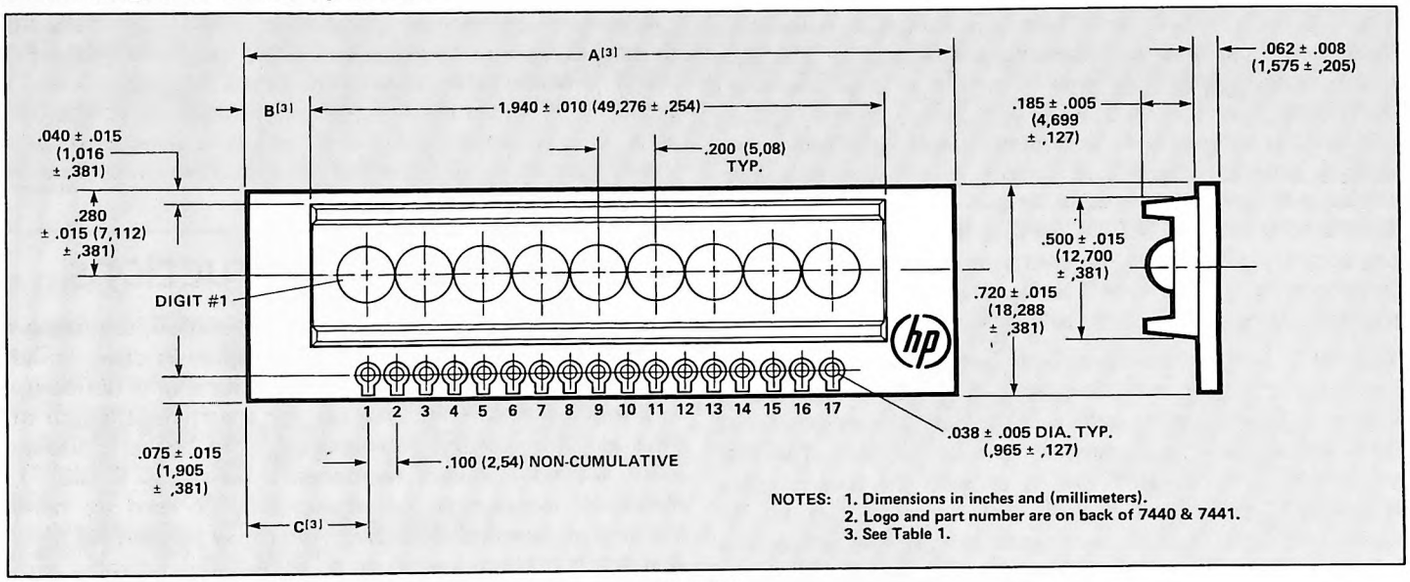
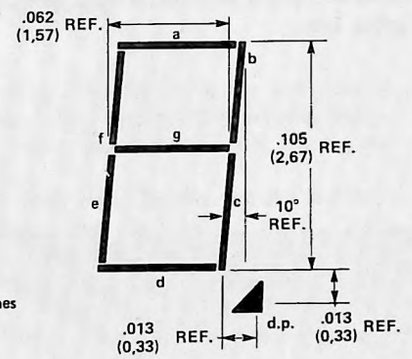


Figure 5.

Magnified Character Font Description

DEVICES
5082-7440
5082-7441
5082-7448
5082-7449



Note: All dimensions in inches and (millimeters).

Figure 6.

Part No.	Dim. A	Dim. B	Dim. C
5082-7440	2.000(50,800)	.030(,760)	.200(5,08)
5082-7441	2.000(50,800)	.030(,760)	.200(5,08)
5082-7448	2.375(60,325)	.217(5,512)	.387(9,830)
5082-7449	2.375(60,325)	.217(5,512)	.387(9,830)

Tolerances: ±.015(,381)

Table 1.

Device Pin Description

Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function	Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function
1	N/C	Dig. 1 Cathode	10	Seg. d Anode	Seg. d Anode
2	Seg. c Anode	Seg. c Anode	11	Dig. 6 Cathode	Dig. 6 Cathode
3	Dig. 2 Cathode	Dig. 2 Cathode	12	Seg. g Anode	Seg. g Anode
4	d.p. Anode	d.p. Anode	13	Dig. 7 Cathode	Dig. 7 Cathode
5	Dig. 3 Cathode	Dig. 3 Cathode	14	Seg. b Anode	Seg. b Anode
6	Seg. a Anode	Seg. a Anode	15	Dig. 8 Cathode	Dig. 8 Cathode
7	Dig. 4 Cathode	Dig. 4 Cathode	16	Seg. f Anode	Seg. f Anode
8	Seg. e Anode	Seg. e Anode	17	Dig. 9 Cathode	Dig. 9 Cathode
9	Dig. 5 Cathode	Dig. 5 Cathode			

Electrical/Optical

The HP 5082-7440 series devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 0.105" (2,67mm). Satisfactory viewing will be realized within an angle of approximately ±20° from the centerline of the digit. Character encoding of the -7440 series devices is performed by standard 7 segment decoder driver circuits.

The 5082-7440 series devices are tested for digit to digit luminous intensity matching using the circuit depicted in Figure 7. Component values are chosen to give an I_F of 5mA per segment at a segment V_F of 1.55 volts. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby insuring excellent digit to digit matching. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical

The 5082-7440 series devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens bar containing 9 individual magnifying elements is attached to the PC board over the digits. The device may be mounted either by use of pins which may be soldered into the plate through holes at the connector edge of the board or by insertion into a standard PC board connector.

The devices may be soldered for up to 5 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended: Wash display in clean liquid Freon T-P 35 or Freon T-E 35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for hand cleaning at room temperature. Water may be used for hand cleaning if it is not permitted to collect under display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

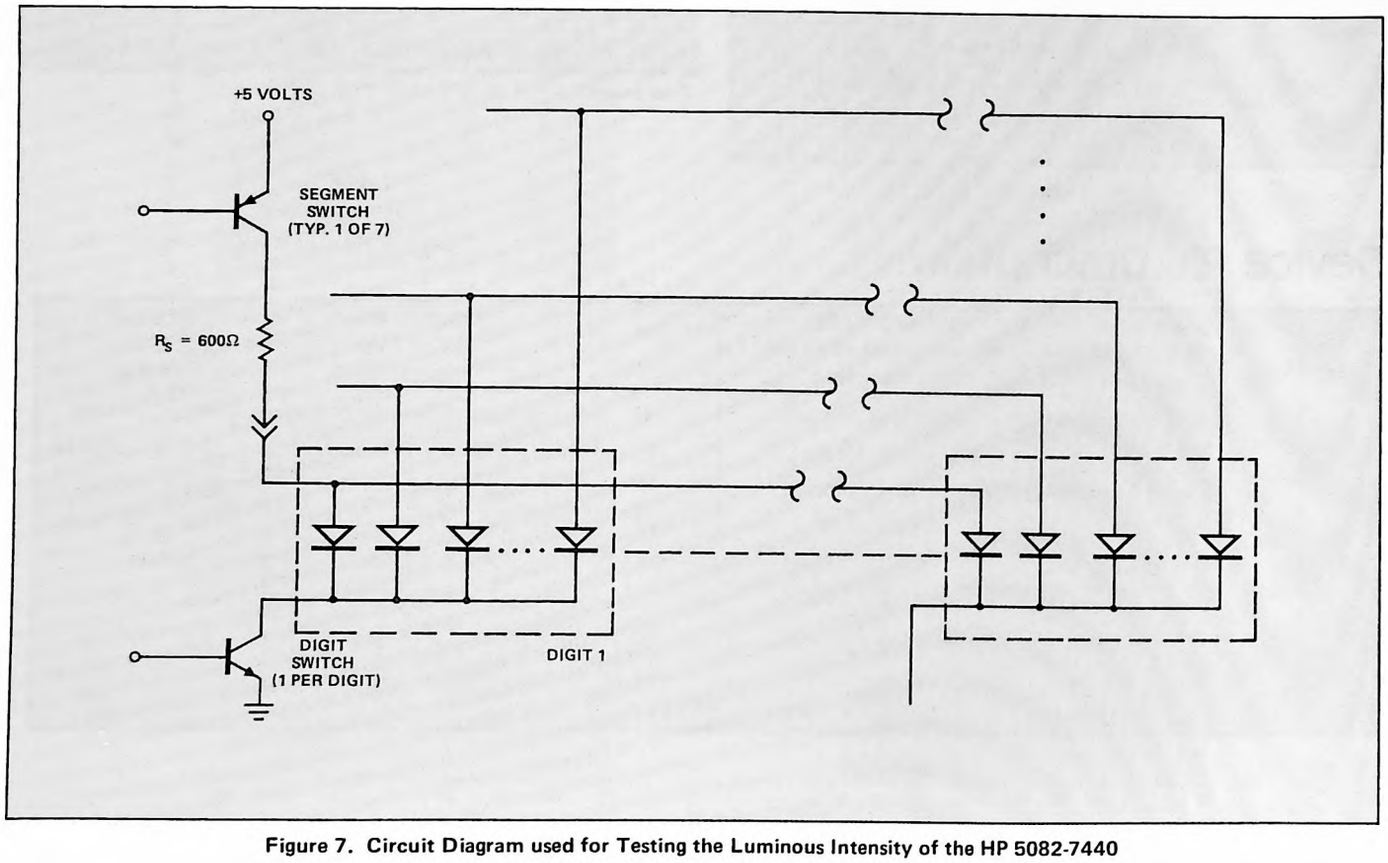


Figure 7. Circuit Diagram used for Testing the Luminous Intensity of the HP 5082-7440

HEWLETT hp PACKARD
COMPONENTS

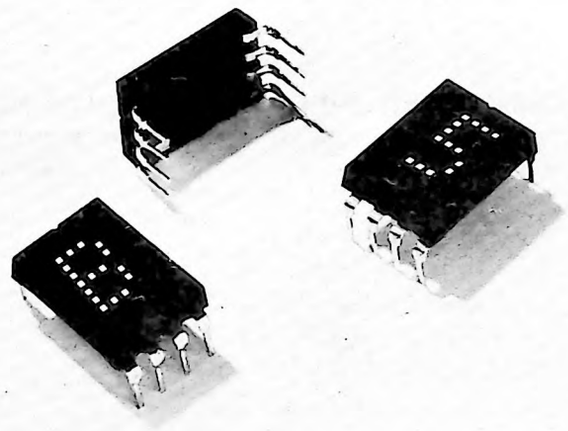
NUMERIC and HEXADECIMAL INDICATORS

5082-7300 SERIES

TECHNICAL DATA JANUARY 1975

FEATURES

- Numeric 5082-7300/-7302
  - 0-9, Test State, Minus Sign, Blank States
  - Decimal Point
    - 7300 Right Hand D.P.
    - 7302 Left Hand D.P.
- Hexadecimal 5082-7340
  - 0-9, A-F, Base 16 Operation
  - Blanking Control, Conserves Power
  - No Decimal Point
- DTL – TTL Compatible
- Includes Decoder/Driver with 5 Bit Memory
  - 8421 Positive Logic Input
- 4 X 7 Dot Matrix Array
  - Shaped Character, Excellent Readibility
- Standard .600 inch X .400 inch Dual-in-Line Package including Contrast Filter
- Categorized for Luminous Intensity
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category



DESCRIPTION

The HP 5082-7300 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide a reliable, low-cost method for displaying digital information.

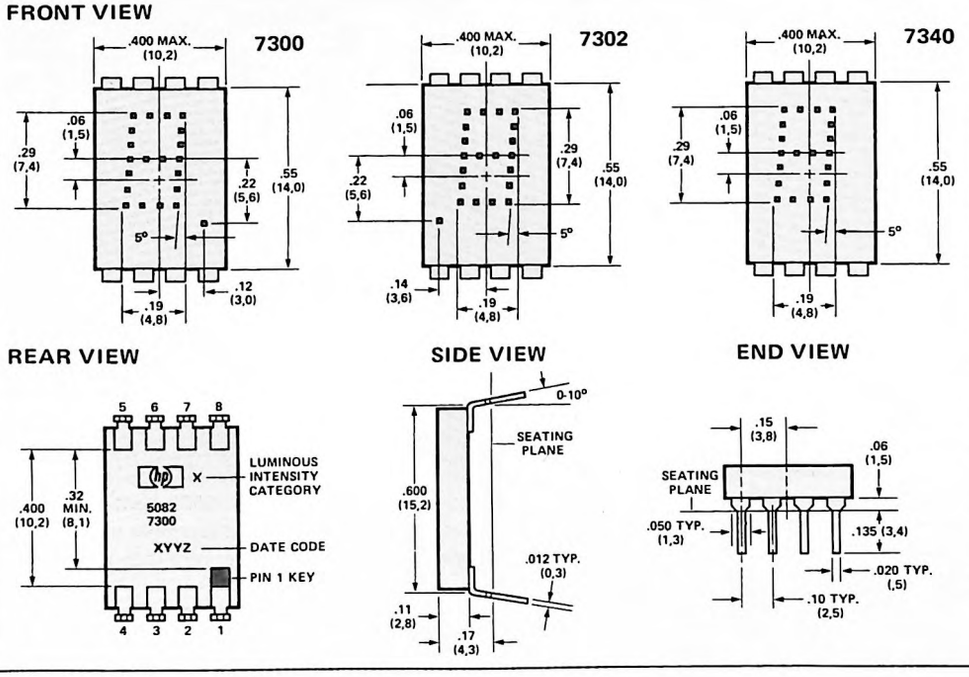
The 5082-7300 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a "–" sign, a test pattern, and four blanks in the invalid BCD states, The unit employs a right-hand decimal point. Typical applications include point-of-sale terminals, instrumentation, and computer systems.

The 5082-7302 is the same as the 5082-7300, except that the decimal point is located on the left-hand side of the digit.

The 5082-7340 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7304 is a "±1" overrange character, including decimal point, used in instrumentation applications.

PACKAGE DIMENSIONS



PIN	FUNCTION	
	5082-7300 and 7302 Numeric	5082-7340 Hexadecimal
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{cc}	V_{cc}
8	Input 1	Input 1

NOTES:

1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ± .015"(±,38mm).
3. Vertical digit center line is ±.02" (±,51mm) from vertical package center line.

ABSOLUTE MAXIMUM RATINGS

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_S	-40	+100	°C
Operating temperature, case	T_C	-20	+85	°C
V_{CC} Pin potential to ground pin	V_{CC}	-0.5	+7.0	V
Voltage applied to input logic pins and decimal point [1]	V_I	-0.5	+5.5	V
Voltage applied to latch enable	V_E	-0.5	+5.5	V
Voltage applied to blanking control [2]	V_B	-0.5	+5.5	V

NOTES: 1. Decimal point applies only to 7300/7302. 2. Applies only to 7340.

RECOMMENDED OPERATING CONDITIONS

DESCRIPTION	SYMBOL	MIN	NOM	MAX	UNIT
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Low Level Input Voltage	V_{IL}	0		0.8	V
High Level Input Voltage	V_{IH}	2.0		5.25	V
Latch enable voltage-data being entered	V_{EL}	0		0.8	V
Latch enable voltage-data not being entered	V_{EH}	2.0		5.25	V
Blanking control voltage-display not blanked [1]	V_{BL}	0		0.8	V
Blanking control voltage-display blanked [1]	V_{BH}	3.5		5.25	V

NOTE: 1. Applies only to 7340.

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = -20°C to +85°C, unless otherwise specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current	I_{CC}	V_{CC} = 5.5V		94[1]	170[2]	mA
Power dissipation	P_T	V_{CC} = 5.5V		470[1]	935[2]	mW
Luminous intensity per LED (Digit average) [3] [5]	I_v	V_{CC} = 5.0V, T_C = 25°C	32	70		μcd
Enable Pulse Width	t_W	V_{CC} = 5.0V, V_{EL} = 0.4V V_{IL} = 0.4V, V_{EH} = 2.4V V_{IH} = 2.4V, T_C = 25°C	120			nsec
Time data must be held before positive transition of enable line	t_{SETUP}		50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}		50			nsec
Time required for 90% change in in display luminous intensity after change of state of V_B [4]	t_{BLANK}	V_{CC} = 5.0V, T_C = 25°C			500	ns
Blanking control current "L" state[4]	I_{BL}	V_{CC} = 5.5V, V_{BL} = 0.8V			200	μA
Blanking control current "H" state[4]	I_{BH}	V_{CC} = 5.5V, V_{BH} = 4.5V			2.0	mA
Logic and latch enable currents "L" state	I_{IL} I_{EL}	V_{CC} = 5.5V V_I, V_E = 0.4V			-1.6	mA
Logic and latch enable currents "H" state	I_{IH} I_{EH}	V_{CC} = 5.5V V_I, V_E = 2.4V			+250	μA
Peak wavelength	λ_{PEAK}	T_C = 25°C		655		nm
Spectral halfwidth	$\Delta\lambda$ ½	T_C = 25°C		30		nm
Weight				0.8		gm

NOTES: 1. V_{CC} = 5.0V with statistical average number of LED's lit. 2. Worst case condition excluding test state on 5082-7300/-7302.
3. The digits are categorized for luminous intensity such that the variation from digit to digit within a category is not discernible to the eye. Intensity categories are designated by a letter located on the reverse side of the package contiguous with the Hewlett-Packard logo marking.
4. Applies only to 7340.
5. I_v as a function of temperature, $I_v(T)$, may be calculated from the relationship; $I_v(T) = I_V(25°C)(.985)^{[T_C-25°C]}$; $I_v(T)$ = Luminous intensity at any particular case temperature; $I_v(25°C)$ = Luminous intensity at T_C = 25°C; T_C = Case temperature at which luminous intensity is to be calculated.

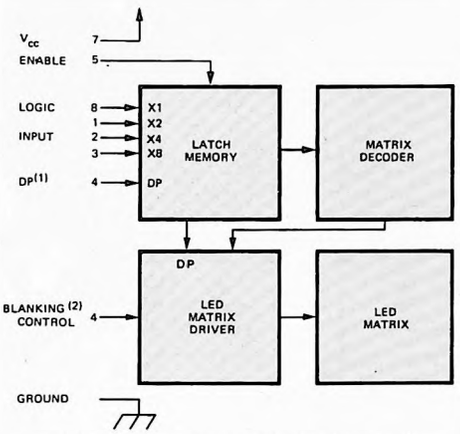
TRUTH TABLE FOR 5082-7300 SERIES DEVICES

CHARACTER		INPUTS					
5082–7300/7302 Numeric	5082–7340 Hex.	X8	X4	X2	X1	E	B [1]
0	0	L	L	L	L	L	L
1	1	L	L	L	H	L	L
2	2	L	L	H	L	L	L
3	3	L	L	H	H	L	L
4	4	L	H	L	L	L	L
5	5	L	H	L	H	L	L
6	6	L	H	H	L	L	L
7	7	L	H	H	H	L	L
8	8	H	L	L	L	L	L
9	9	H	L	L	H	L	L

CHARACTER		INPUTS					
5082-7300/7302 NUMERIC	5082–7340 Hex.	X8	X4	X2	X1	E	B [1]
Test	A	H	L	H	L	L	L
Blank	B	H	L	H	H	L	L
Blank	C	H	H	L	L	L	L
Minus	D	H	H	L	H	L	L
Blank	E	H	H	H	L	L	L
Blank	F	H	H	H	H	L	L
Hold	Hold	X	X	X	X	H	X
–	Blank [1]	X	X	X	X	X	H
Decimal pt. on [2]	–	$DP_I = L$					
Decimal pt. off [2]	–	$DP_I = H$					

NOTES:

1. The blanking control input, B, pertains to the 5082-7340 Hexadecimal indicator only.
2. The decimal point input pertains to the 5082-7300 and -7302 Numeric Indicators only.
3. H = logic 'High'; L = logic 'Low'; x = 'don't care'.



Notes 1. 5082 – 7300/-7302 only
2. 5082 – 7340 only

Figure 1. Block Diagram of 5082-7300 Series Logic.

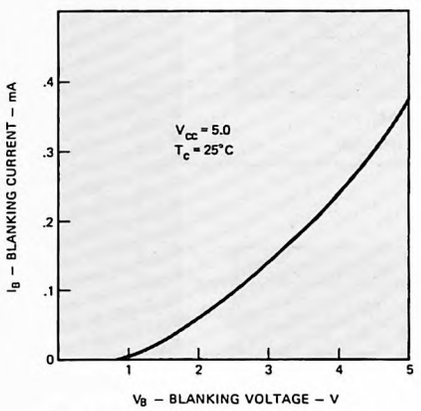


Figure 2. Typical Blanking Control Current Vs. Voltage for 5082-7340 Only.

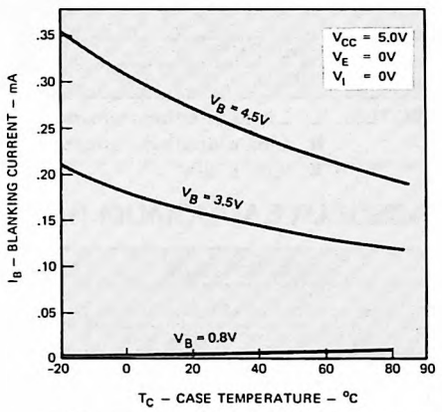


Figure 3. Typical Blanking Control Input Current Vs. Temperature, 5082-7340.

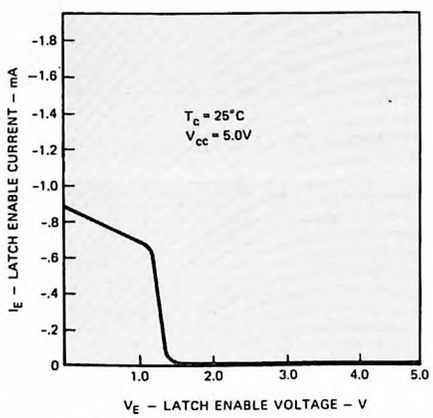


Figure 4. Typical Latch Enable Input Current Vs. Voltage for the 5082-7300 Series Devices.

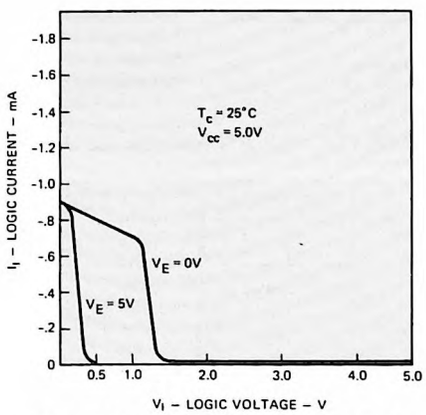


Figure 5. Typical Logic and Decimal Point Input Current Vs. Voltage for the 5082-7300 Series Devices. Decimal Point Applies to 5082-7300 Only.

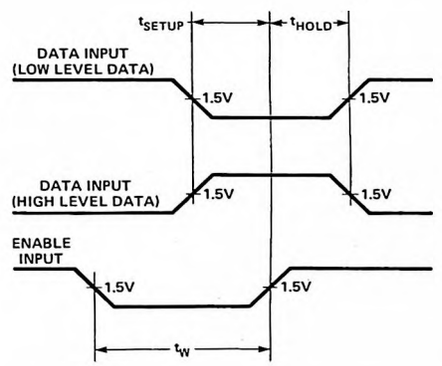
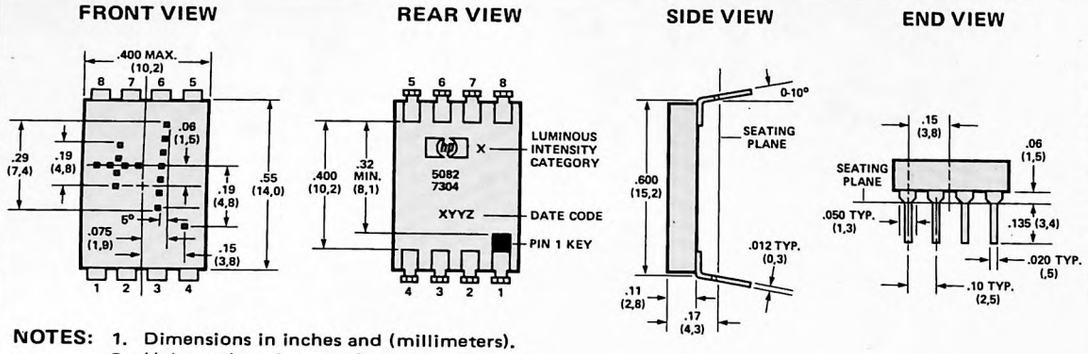


Figure 6. Timing Diagram of 5082-7300 Series Logic.

SOLID STATE OVER RANGE CHARACTER

For display applications requiring a ±, 1, or decimal point designation, the 5082-7304 over range character is available. This display module comes in the same package as the 5082-7300 series numeric indicator and is completely compatible with it.

PACKAGE DIMENSIONS



PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	V_{cc}
8	Minus/Plus

NOTES: 1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches. (±,38mm)

5082–7304

TRUTH TABLE FOR 5082-7304

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
–	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Fig. 7 cutoff.
H: Line switching transistor in Fig. 7 saturated.
X: 'don't care'

ABSOLUTE MAXIMUM RATINGS

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_s	-40	+100	°C
Operating temperature, case	T_C	-20	+85	°C
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{cc}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to figure 7 for recommended resistor values.

TYPICAL DRIVING CIRCUIT FOR 5082-7304.

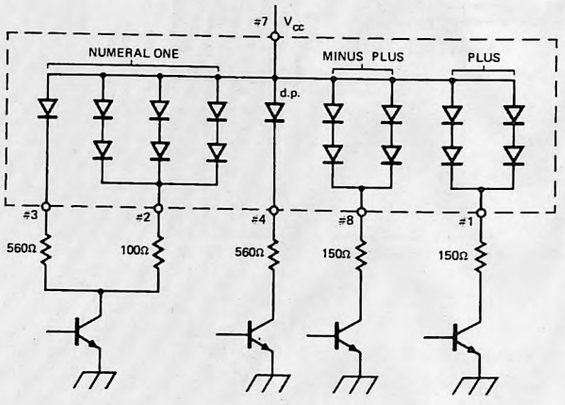


Figure 7.

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = -20°C TO +85°C, UNLESS OTHERWISE SPECIFIED)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	I_F = 10 mA		1.6	2.0	V
Power dissipation	P_T	I_F = 10 mA all diodes lit		250	320	mW
Luminous Intensity per LED (digit average)	I_v	I_F = 6 mA T_C = 25°C	32	70		µcd
Peak wavelength	λ_{peak}	T_C = 25°C		655		nm
Spectral halfwidth	$\Delta\lambda_{1/2}$	T_C = 25°C		30		nm
Weight				0.8		gm

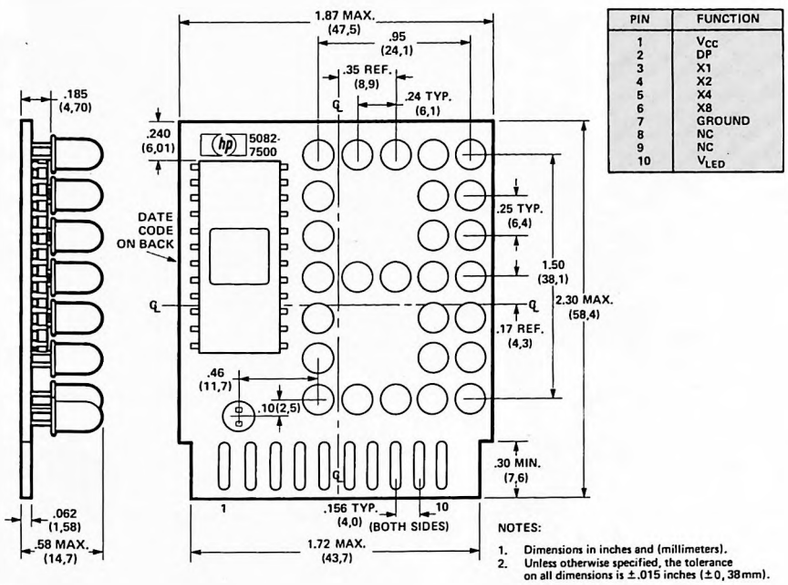
HEWLETT hp PACKARD

COMPONENTS

SOLID STATE NUMERIC 1.5" INDICATOR

5082-7500

TECHNICAL DATA JANUARY 1975



PIN	FUNCTION
1	V_{CC}
2	DP
3	X1
4	X2
5	X4
6	X8
7	GROUND
8	NC
9	NC
10	V_{LED}

NOTES:
1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches (±0,38mm).

Features

- **1.5 Inch High Character**
  - **Readable From 60 Feet**
- **On-Board Decoder/Driver**
  - **8421 Positive Logic Input**
  - **DTL-TTL Compatible**
- **5 x 7 Dot Matrix**
  - **Shaped Character For Excellent Readability**
- **Single Plane Construction**
  - **Wide Viewing Angle**
- **Edge Mounting in Standard PC Board Connectors (.156" centers)**
- **Reliable, Rugged, Long Operating Life**

Description

The HP 5082-7500 is a 1.5" numeric indicator utilizing discrete red light emitting diodes arranged in a 5 x 7 dot matrix. Inclusion of the decoder/driver permits direct addressing by the standard BCD code.

The large size and high efficiency light emitters permit viewing distances up to 60 feet. The single plane of light emitters permits wide viewing angles and low mounting space requirements. Applications include equipment for scales, process control and medical measurement, and other data systems requiring ease of readability at a distance.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	–40	85	°C
Operating Temperature, Ambient	T_A	–20	70	°C
Logic Supply Voltage [1]	V_{CC}	–0.5	7	V
LED Supply Voltage [1, 2]	V_{LED}	–0.5	5.25	V
Voltage Applied to BCD [1, 2] and Decimal Point Inputs	V_I	–0.5	5.25	V

[1] Voltage values are with respect to ground pin. [2] V_I or V_{LED} not to exceed V_{CC} by more than 0.5V at any time.

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Logic Supply Voltage	V_{CC}	4.5	5.0	5.5	V
LED Supply Voltage, Display ON [1]	V_{LED}	4.5	5.0	5.25	V
LED Supply Voltage, Display OFF [2]	V_{LED}	–0.5	0	1.0	V
Operating Temperature, Ambient	T_A	–20	25	70	°C

[1] All selected LEDs remain uniformly lit. [2] All LEDs remain off.

Electrical / Optical Characteristics (T_A = –20°C to 70°C, Unless Noted)

Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Logic Voltage, "L" State	V_{IL}	V_{CC} = 4.5V	0		0.8	V
Logic Voltage, "H" State	V_{IH}	V_{CC} = 5.5V	2.0		5.25	V
Logic Supply Current	I_{CC}	V_{CC} = 5.5V		37 [1]	65	mA
LED Supply Current	I_{LED}	V_{CC} = 5.5V, V_{LED} = 5.25V		250 [1]	460	mA
Power Dissipation	P_D	V_{CC} = 5.5V, V_{LED} = 5.25V		1.4 [1]	2.8	W
Luminous Intensity per LED (digit average)	I	V_{CC} = 5.0V, V_{LED} = 5.0V T_A = 25°C	0.8	1.25		mcd
Logic Current, "L" State	I_{IL}	V_{CC} = 5.5V, V_{in} = 0.4V			–1.6	mA
Logic Current, "H" State	I_{IH}	V_{CC} = 5.5V, V_{in} = 2.4V			+100	μA
Decimal Point Current	I_{dp} [3]	V_{CC} =5.5V, V_{LED} = 5.25V V_{dp} = 0.4V		–25 [2]	–35	mA
Peak Wavelength	λ_{peak}			655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				25		gm

[1] V_{CC}=5.0V, V_{LED}=5.0V with statistical average number of LEDs lit, T_A=25°C. [2] V_{CC}=5.0V, V_{LED}=5.0V, T_A=25°C.

[3] Pin 2 is connected to the decimal point LED thru a 120Ω series current limiting resistor. This pin should be connected to ground thru a NPN switching transistor.

Truth Table

Character	X8	X4	X2	X1
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
BLANK	H	L	H	L
BLANK	H	L	H	H
BLANK	H	H	L	L
BLANK	H	H	L	H
BLANK	H	H	H	L
BLANK	H	H	H	H
D.P. ON		D.P. (IN) = L		
D.P. OFF		D.P. (IN) = H		

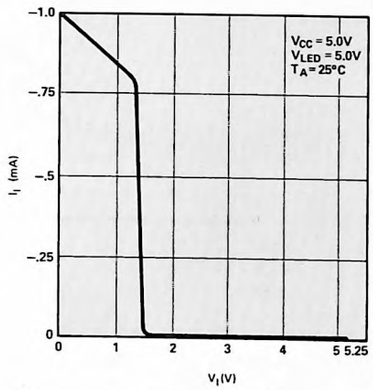


Figure 1. Typical BCD logic input current vs. input voltage.

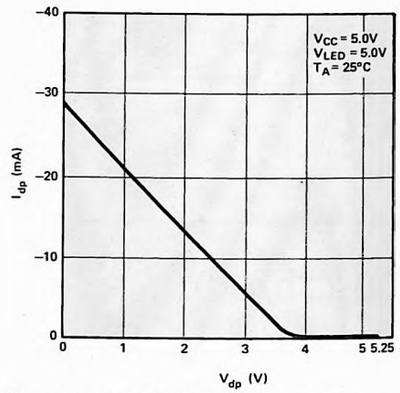


Figure 2. Typical decimal point input current as a function of dp input voltage.

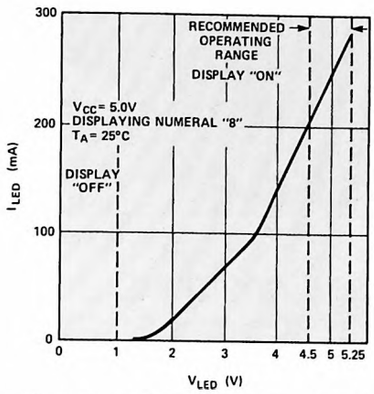


Figure 3. Typical I_{LED} as a function of V_{LED}.

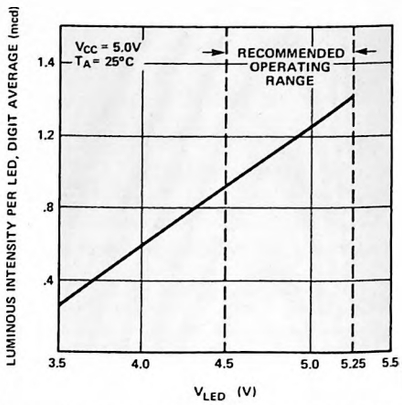


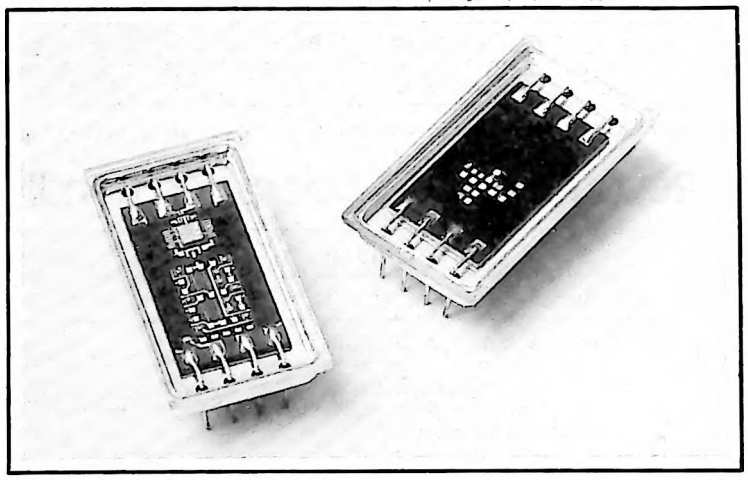
Figure 4. Typical luminous intensity per LED (digit average) as a function of V_{LED}.

HEWLETT hp PACKARD
COMPONENTS

SOLID STATE NUMERIC INDICATOR

5082-7010
5082-7011

TECHNICAL DATA JANUARY 1975



Features

- RUGGED, SHOCK RESISTANT, HERMETIC
- DESIGNED TO MEET MIL STANDARDS
- INCLUDES DECODER/DRIVER – BCD INPUTS
- TTL/DTL COMPATIBLE
- CONTROLLABLE LIGHT OUTPUT
- 5x7 LED MATRIX CHARACTER

Description

The HP 5082-7010 solid state numeric indicator with built-in decoder/driver provides a hermetically tested 0.27" display for use in military or adverse industrial environments. Typical applications include ground, airborne and shipboard equipment, fire control systems, medical instruments, and space flight systems.

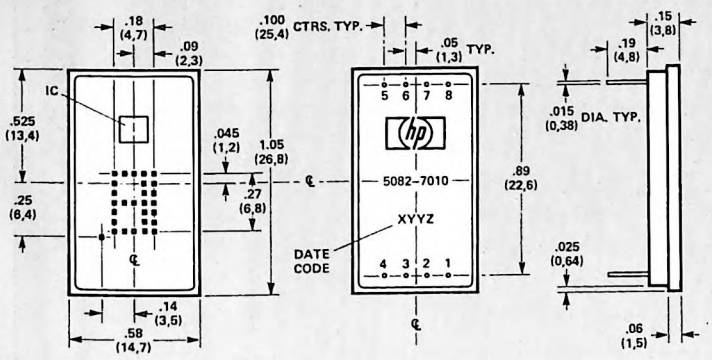
The 5082-7010 is a modified 5x7 matrix display that indicates the numerals 0-9 when presented with a BCD code. The BCD code is negative logic with blanks displayed for invalid codes. A left-hand decimal point is included which must be externally current limited.

The 5082-7011 is a companion plus/minus sign in the same hermetically tested package. Plus/minus indications require only that voltage be applied to two input pins.

Both displays allow luminous intensity to be varied by changing the DC drive voltage or by pulse duration modulation of the LED voltage.

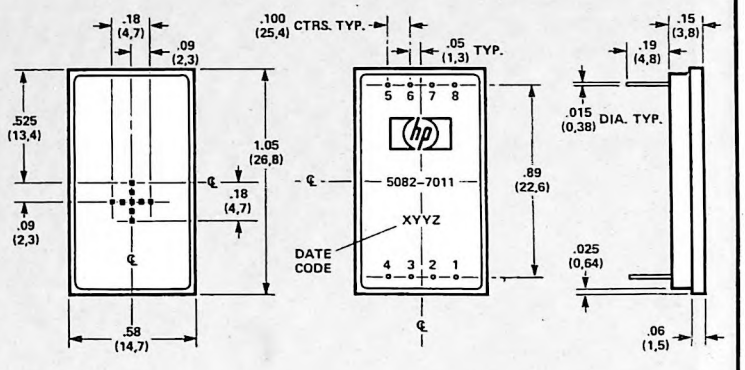
Package Dimensions

5082-7010



PIN	FUNCTION	PIN	FUNCTION
1	Input 1	5	Input 4
2	V_{DP}	6	Ground
3	V_{LED}	7	V_{CC}
4	Input 8	8	Input 2

5082-7011



PIN	FUNCTION	PIN	FUNCTION
1	NC	5	NC
2	NC	6	Ground
3	Plus	7	Minus/Plus
4	NC	8	NC

Notes:
1. Unless otherwise specified, the tolerance on all dimensions is ±0.015 inches (±0,38mm).
2. All dimensions in inches and (millimeters).
3. The package and mounting pins are tin plated Kovar.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	−65	+100	°C
Operating Temperature, Case	T_C	−55	+95	°C
Logic Supply Voltage to Ground	V_{CC}	−0.5	+7.0	V
Logic Input Voltage	V_I	−0.5	+5.5	V
LED Supply Voltage to Ground	V_{LED} [1]	−0.5	+5.5	V
Decimal Point Current	I_{DP}		−10	mA

Note: 1. Above T_C = 65°C derate V_{LED} per derating curve in Figure 10.

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Logic Supply Voltage	V_{CC}	4.5	5.0	5.5	V
LED Supply Voltage, Display Off	V_{LED}	−0.5	0	+1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V
Decimal Point Current	I_{DP}[2]	0	−5.0	−10.0	mA
Logic Input Voltage, "H" State	V_{IH}	2.0		5.5	V
Logic Input Voltage, "L" State	V_{IL}	0		0.8	V

Note: 2. Decimal point current must be externally current limited. See application information.

Electrical/Optical Characteristics

Case Temperature, T_C = 0°C to 70°C, unless otherwise specified

Description	Symbol	Test Conditions		Min.	Typ. [4]	Max.	Unit
Logic Supply Current	I_{CC}	V_{CC} = 5.5V			45	75	mA
LED Supply Current	I_{LED} [3] [5]	V_{CC}	V_{LED}				mA
		5.5V	5.5V		255	350	
		5.5V	4.2V		170	235	
		5.5V	3.5V		125		
Logic Input Current, "H" State (ea. input)	I_{IH}	V_{CC} = 5.5V V_{IH} = 2.4V				100	µA
Logic Input Current, "L" State (ea. input)	I_{IL}	V_{CC} = 5.5V V_{IL} = 0.4V				−1.6	mA
Decimal Point Voltage Drop	V_{LED} − V_{DP}	I_{DP} = −10mA			1.6	2.0	V
Power Dissipation	P_T [3] [5]	V_{CC}	V_{LED}				W
		5.5V	5.5V		1.7	2.3	
		5.5V	4.2V		1.0	1.4	
		5.5V	3.5V		0.7		
Luminous Intensity per LED (digit avg.)	I_v	V_{LED}	T_C				µcd
		5.5V	25°C	60	115		
		4.2V	25°C	40	80		
		3.5V	25°C		50		
Peak Wavelength	λ_{peak}				655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$				30		nm
Weight					4.9		gram

Notes:
3. With numeral 8 displayed.
4. All typical values at T_C = 25°C.
5. T_C = 0°C to 65°C for V_{LED} = 5.5V.

Truth Table

Character	Logic X8	X4	X2	X1	
0	H	H	H	H	0
1	H	H	H	L	1
2	H	H	L	H	2
3	H	H	L	L	3
4	H	L	H	H	4
5	H	L	H	L	5
6	H	L	L	H	6
7	H	L	L	L	7
8	L	H	H	H	8
9	L	H	H	L	9
Blank	L	H	L	H	
Blank	L	H	L	L	
Blank	L	L	H	H	
Blank	L	L	H	L	
Blank	L	L	L	H	
Blank	L	L	L	L	

V_{IL} = 0.0 to 0.8V
V_{IH} = 2.0 to 5.5V

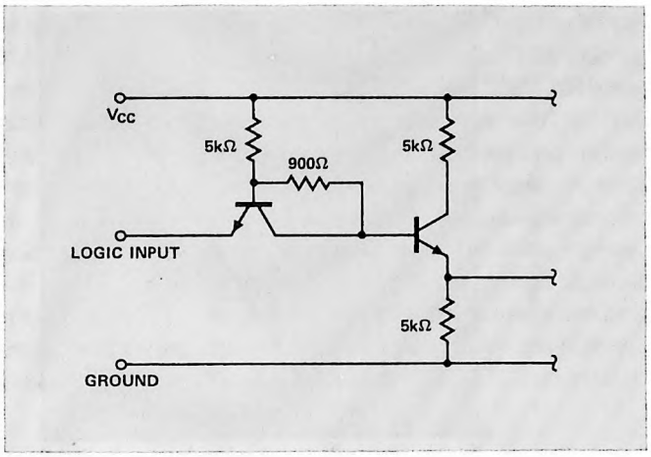


Figure 1. Equivalent input circuit of the 5082-7010 decoder. Note: Display metal case is isolated from ground pin #6.

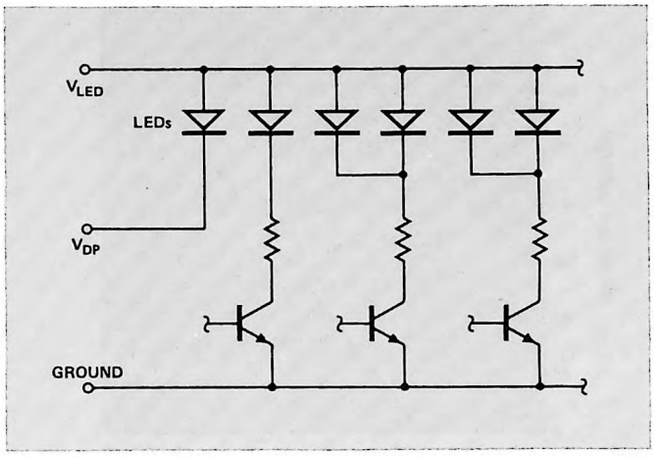


Figure 2. Equivalent circuit of the 5082-7010 as seen from LED and decimal point drive lines.

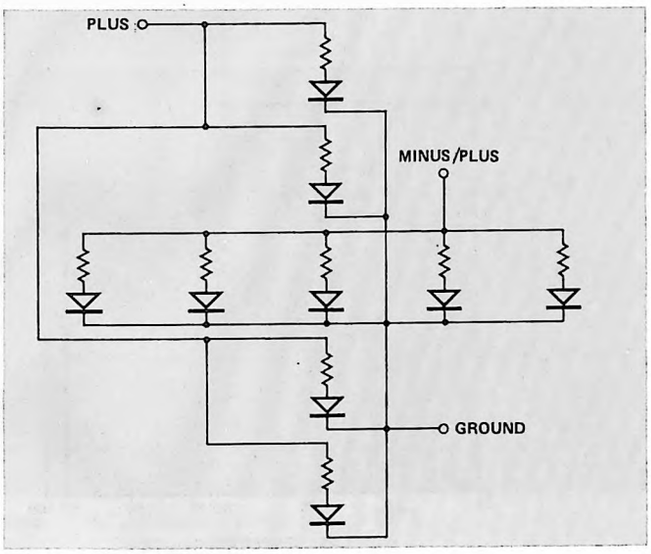


Figure 3. Equivalent circuit of 5082-7011 plus/minus sign. All resistors 345Ω typical. Note: Display metal case is isolated from ground pin #6.

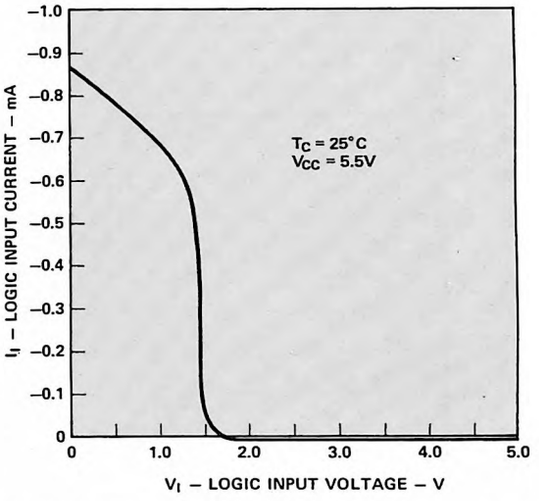


Figure 4. Input current as a function of input voltage, each input.

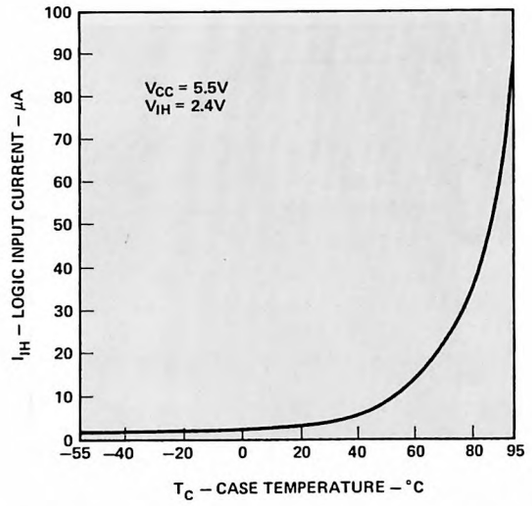


Figure 5. Logic "H" input current as a function of case temperature, each input.

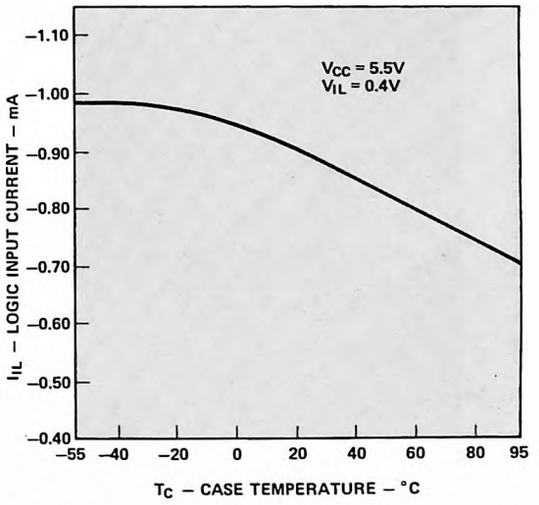


Figure 6. Logic "L" input current as a function of case temperature, each input.

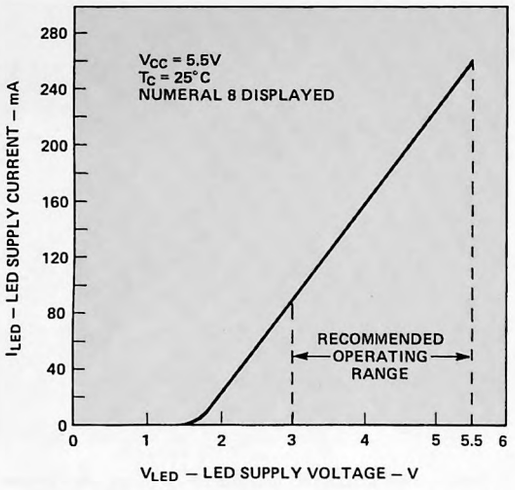


Figure 7. LED supply current as a function of LED supply voltage.

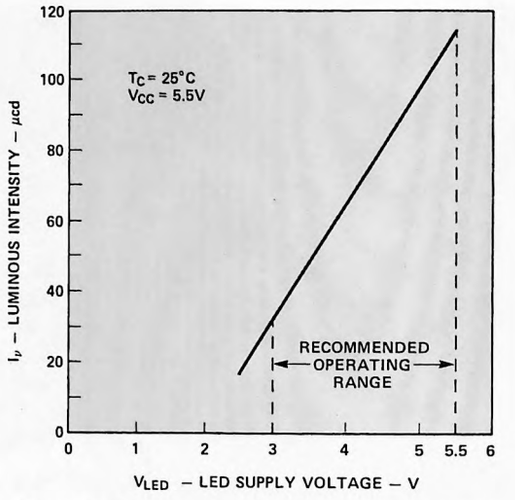


Figure 8. Luminous intensity per LED (digit average) as a function of LED supply voltage.

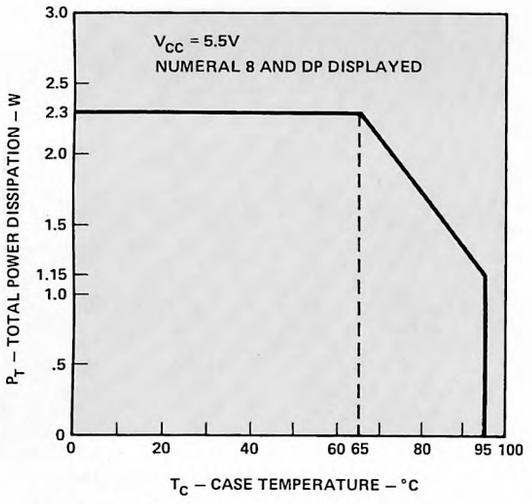


Figure 9. Maximum power derating as a function of case temperature.

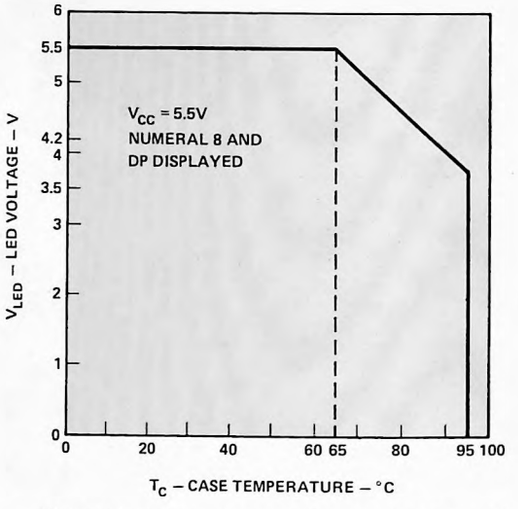


Figure 10. LED voltage derating as a function of case temperature.

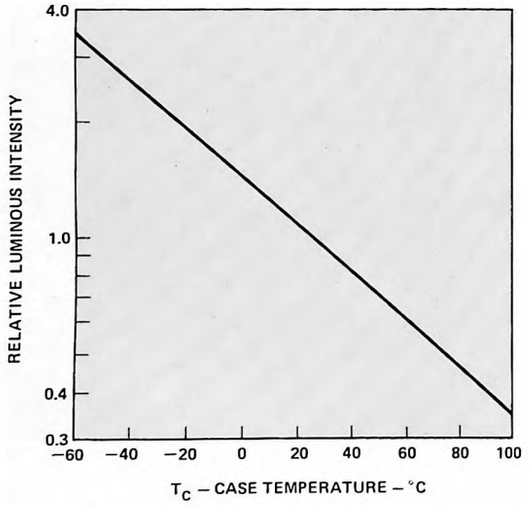


Figure 11. Relative luminous intensity as a function of case temperature at fixed current level.

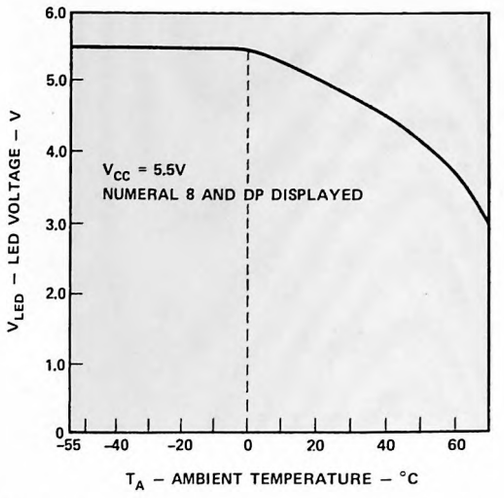


Figure 12. LED voltage derating as a function of ambient temperature, display soldered into P.C. board without heat sink.

Solid State Plus/Minus Sign 5082-7011

For display applications requiring ± designation, the 5082-7011 solid state plus/minus sign is available. This display module comes in the same package as the 5082-7010 numeric indicator and is completely compatible with it. Plus or minus information can be indicated by supplying voltage to one (minus sign) or two (plus sign) input leads. A third lead is provided for the ground connection. Luminous intensity is controlled by changing the LED drive voltage. Each LED has its own built-in 345Ω (nominal) current limiting resistor. Therefore, no external current limiting is required for voltages at 5.5V or lower. Like the numeric indicator, the -7011 plus/minus sign is TTL/DTL compatible.

Truth Table

CHARACTER	PIN	
	3	7
+	H	H
–	L	H
Blank	L	L

V_L = –0.5 to 1.0V

V_H = 3.0 to 5.5V

Electrical/Optical Characteristics

Case Temperature, T_C = 0°C to 70°C, unless otherwise specified

Description	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Unit
LED Supply Current	I_{LED}	V_{LED} = 5.5V		105	150	mA
		V_{LED} = 4.2V		70	100	
Power Dissipation	P_T	V_{LED} = 5.5V		0.6	0.9	W
		V_{LED} = 4.2V		0.3	0.6	
Luminous Intensity per LED (Digit Avg.)	I_v [2]	V_{LED} = 5.5V	60	115		μcd
		V_{LED} = 4.2V	40	80		
		V_{LED} = 3.5V		50		
Peak Wavelength	λ_{peak}			655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				4.9		gram

Notes:
1. All typical values at T_C = 25°C
2. At T_C = 25°C

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	–65	+100	°C
Operating Temperature, Case	T_C	–55	+95	°C
Plus, Plus/Minus Input Potential to Ground	V_{LED}	–0.5	5.5	V

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
LED Supply Voltage, Display Off	V_{LED}	–0.5	0	1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V

Applications

Decimal Point Limiting Resistor

The decimal point of the 5082-7010 display requires an external current limiting resistor, between pin 2 and ground. Recommended resistor value is 220Ω, 1/4 watt.

Mounting

The 5082-7010 and 5082-7011 displays are packaged with two rows of 4 contact pins each in a DIP configuration with a row center line spacing of 0.890 inches.

Normal mounting is directly onto a printed circuit board. If desired, these displays may be socket mounted using contact strip connectors such as Augat's 325-AGI or AMP 583773-1 or 583774-1.

Heat Sink Operation

Optimum display case operating temperature for the 5082-7010 and 7011 displays is T_C=0°C to 70°C as measured on back surface. Maintaining the display case operating temperature within this range may be achieved by mounting the display on an appropriate heat sink or metal core printed circuit board. Thermal conducting compound such as Wakefield 120 or Dow Corning 340 can be used between display and heat sink. See figure 10 for V_{LED} derating vs. display case temperature.

Operation Without Heat Sink

These displays may also be operated without the use of a heat sink. The thermal resistance from case to ambient for these displays when soldered into a printed circuit board is nominally θ_{CA}=30°C/W. See figure 12 for V_{LED} derating vs. ambient temperature.

Cleaning

For cleaning and flux removal, the following solvents are recommended: Water, Isoproponal, Freon TF and Freon TE. The displays may be cleaned with the above listed Freons at boiling temperature for time period of up to two minutes.

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COMPONENTS

SOLID STATE NUMERIC INDICATOR

5082-7001

TECHNICAL DATA JANUARY 1975

Features

- **Rugged, Shock Resistant, Hermetic**
- **Designed to Meet MIL Standards**
- **Includes Decoder/Driver — BCD Inputs**
- **TTL/DTL Compatible**
- **Controllable Light Output**
- **5 x 7 LED Matrix Character**

Description

The HP 5082-7001 triple digit solid state numeric indicator with built-in decoder/driver provides a hermetically tested 0.27" display for use in military or adverse industrial environments. Typical applications include ground, airborne and shipboard equipment, fire control systems, medical instruments, and space flight systems.

The 5082-7001 is a modified 5 x 7 matrjx display that indicates the numerals 0-9 when presented with a BCD code. The BCD code is negative logic with blanks displayed for invalid codes. A left-hand decimal point is included which must be externally current limited.

The 5082-7010 is a single digit version of the 5082-7001 solid state numeric indicator. The 5082-7011 is a companion plus/minus sign in the same single digit hermetically tested package used for the 5082-7010. Plus/minus indications require only that voltage be applied to two input pins.

All three displays allow luminous intensity to be varied by changing the DC drive voltage or by pulse duration modulation of the LED voltage.

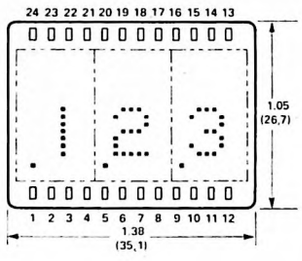
Electrical/Optical Specifications

The 5082-7010/11 data sheet lists the electrical/optical specifications for the 5082-7001 and 5082-7010/11 displays.

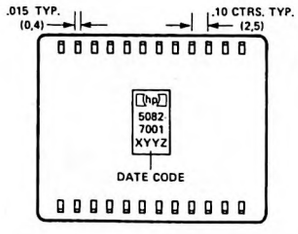
Package Dimensions

5082-7001

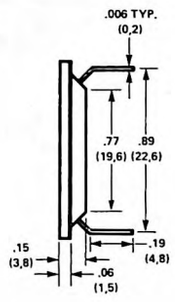
FRONT VIEW



REAR VIEW



SIDE VIEW



FUNCTION	PIN 5082-7001 Digit 1	Digit 2	Digit 3
Input 1	1	5	9
Input 2	24	20	16
Input 4	21	17	13
Input 8	4	8	12
V_{CC}	23	19	15
V_{LED}	3	7	11
V_{DP} (Decimal Point)	2	6	10
Ground	22	18	14

NOTES:

1. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches and (±0,38 mm.).
2. All dimensions in inches and (millimeters).
3. The 5082-7010/11 data sheet gives the package dimensions and pin out function table for these displays.

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COMPONENTS

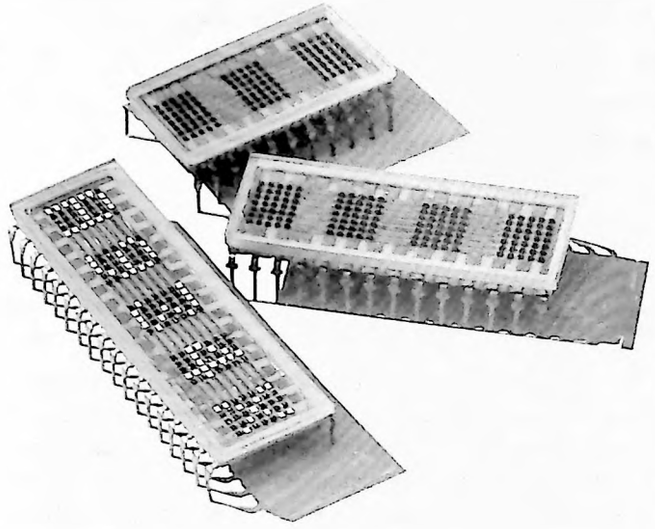
LED SOLID STATE ALPHANUMERIC INDICATOR

5082-7100
5082-7101
5082-7102

TECHNICAL DATA JANUARY 1975

Features

- 5 x 7 LED Matrix Character
  - Human Factors Engineered
- Brightness Controllable
- IC Compatible
- Small Size
  - Standard .600 inch Dual In-Line Package
  - .27 inch Character Height
- Wide Viewing Angle
- Rugged, Shock Resistant
  - Hermetically Sealed
  - Designed to Meet MIL Standards
- Long Operating Life



Description

The Hewlett-Packard 5082-7100 Series is an X-Y addressable, 5 x 7 LED Matrix capable of displaying the full alphanumeric character set. This alphanumeric indicator series is available in 3, 4, or 5 character end-stackable clusters. The clusters permit compact presentation of information, ease of character alignment, minimum number of interconnections, and compatibility with multiplexing driving schemes.

Alphanumeric applications include computer terminals, calculators, military equipment and space flight readouts.

The **5082-7100** is a three character cluster.
The **5082-7101** is a four character cluster.
The **5082-7102** is a five character cluster.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current Per LED (Duration < 1 ms)	I_{peak}		100	mA
Average Current Per LED	I_{AVG}		10	mA
Power Dissipation Per Character (All diodes lit) [1]	P_D		700	mW
Operating Temperature, Case	T_C	–55	95	°C
Storage Temperature	T_S	–55	100	°C
Reverse Voltage Per LED	V_R		4	V

Note 1: At 25°C Case Temperature; derate 8.5 mW/°C above 25°C.

Electrical / Optical Characteristics at $T_C = 25°C$

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak Luminous Intensity Per LED (Character Average) @ Pulse Current of 100mA/LED	$I_{v\ (peak)}$	1.0	2.2		mcd
Reverse Current Per LED @ $V_R = 4V$	I_R		10		μA
Peak Forward Voltage @ Pulse Current of 50mA/LED	V_F		1.7	2.0	V
Peak Wavelength	λ_{peak}		655		nm
Spectral Line Halfwidth	$\Delta\lambda_{1/2}$		30		nm
Rise and Fall Times [1]	t_r, t_f		10		ns

Note 1. Time for a 10% - 90% change of light intensity for step change in current.

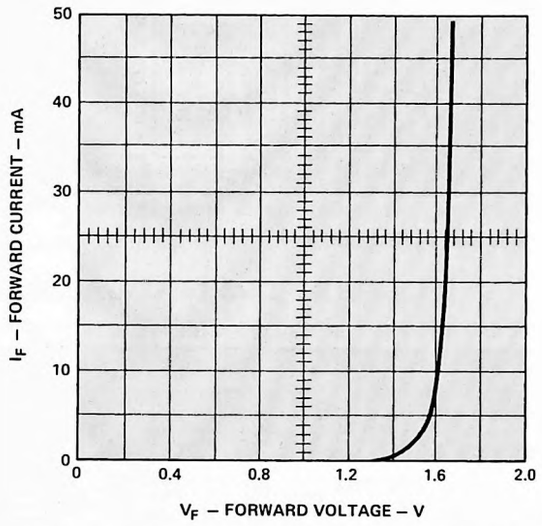


Figure 1. Forward Current-Voltage Characteristic.

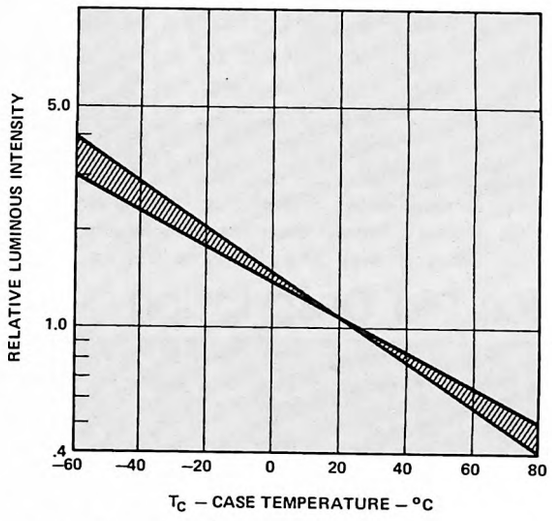


Figure 2. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

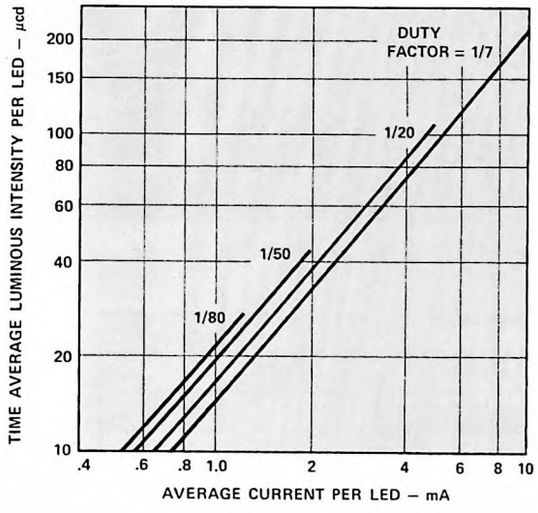


Figure 3. Typical Time Average Luminous Intensity per LED vs. Average Current per LED.

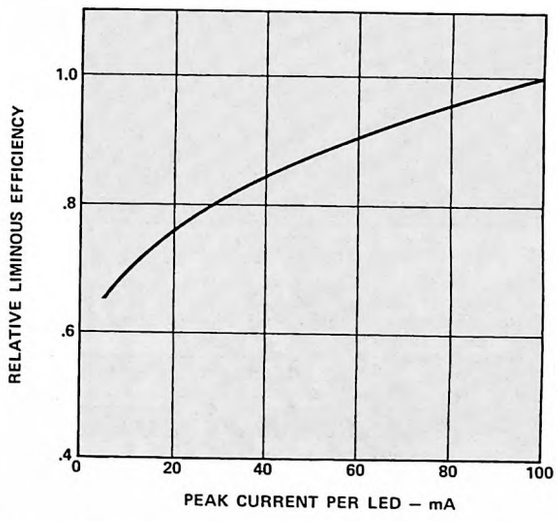
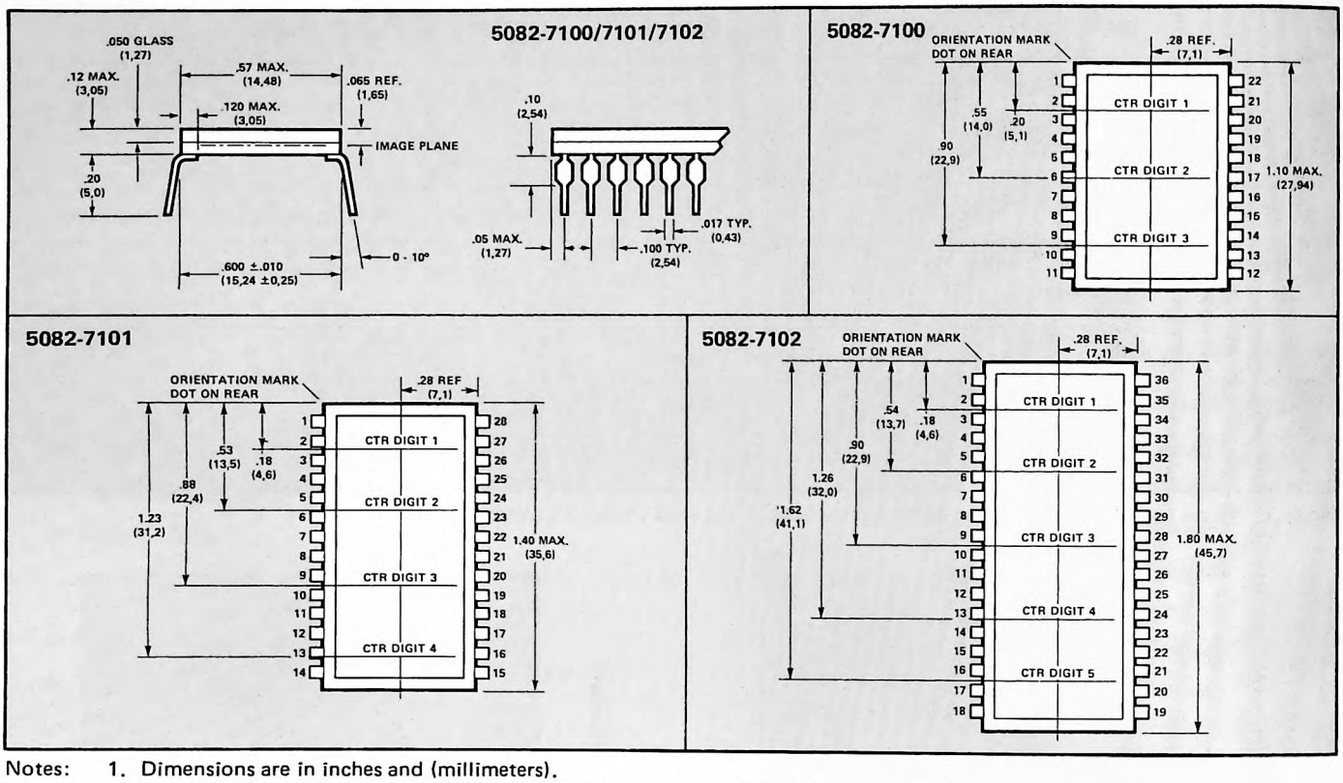


Figure 4. Typical Relative Luminous Efficiency vs. Peak Current per LED.

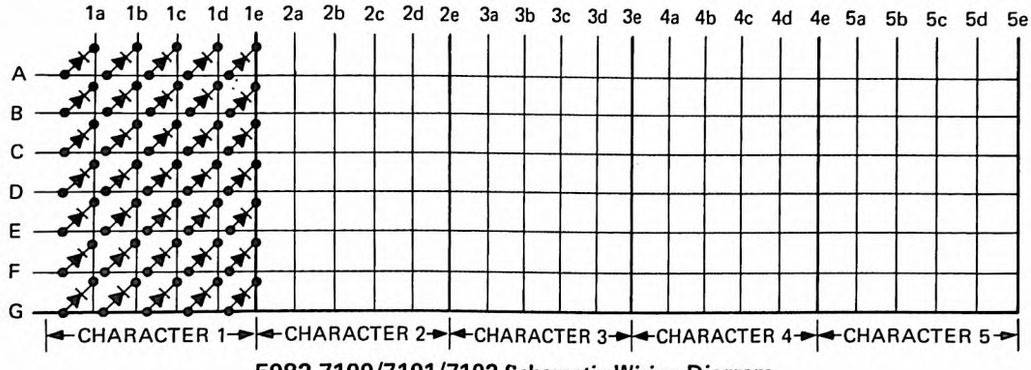
Package Dimensions and Pin Configurations



Notes:
1. Dimensions are in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches (±0,38mm).
3. Character Size .27 x .19 inches (6, 9 x 4, 9mm).

Device Pin Description

5082-7100				5082-7101				5082-7102			
Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	Anode G	12	Anode B	1	N/C	15	Anode C	1	N/C	19	5e
2	1c	13	3d	2	1c	16	4c	2	1c	20	5c
3	1d	14	3b	3	1e	17	4a	3	1e	21	5a
4	Anode F	15	Anode A	4	Anode G	18	Anode B	4	Anode F	22	Anode D
5	Anode E	16	2e	5	2b	19	3e	5	2b	23	4e
6	2b	17	2c	6	2d	20	3b	6	2d	24	4c
7	2d	18	2a	7	Anode D	21	3a	7	2e	25	N/C
8	Anode C	19	Anode D	8	Anode E	22	2e	8	Anode E	26	Anode C
9	3a	20	1e	9	3c	23	2c	9	3c	27	3d
10	3c	21	1b	10	3d	24	2a	10	3e	28	3b
11	3e	22	1a	11	Anode F	25	Anode A	11	Anode G	29	3a
				12	4b	26	1d	12	4a	30	Anode B
				13	4d	27	1b	13	4b	31	2c
				14	4e	28	1a	14	4d	32	2a
								15	N/C	33	Anode A
								16	5b	34	1d
								17	5d	35	1b
								18	N/C	36	1a



5082-7100/7101/7102 Schematic Wiring Diagram

Operating Considerations

ELECTRICAL

The 5 x 7 matrix of LED's, which make up each character, are X-Y addressable. This allows for a simple addressing, decoding and driving scheme between the display module and customer furnished logic.

There are three main advantages to the use of this type of X-Y addressable array:

1. It is an elementary addressing scheme and provides the least number of interconnection pins for the number of diodes addressed. Thus, it offers maximum flexibility toward integrating the display into particular applications.
2. This method of addressing offers the advantage of sharing the Read-Only-Memory character generator among several display elements. One character generating ROM can be shared over 25 or more 5 x 7 dot matrix characters with substantial cost savings.
3. In many cases equipments will already have a portion of the required decoder/driver (timing and clock circuitry plus buffer storage) logic circuitry available for the display.

To form alphanumeric characters a method called "scanning" or "strobing" is used. Information is addressed to the display by selecting one row of diodes at a time, energizing the appropriate diodes in that row and then proceeding to the next row. After all rows have been excited one at a time, the process is repeated. By scanning through all rows at least 100 times a second, a flicker free character can be produced. When information moves sequentially from row to row of the display (top to bottom) this is row scanning, as illustrated in Figure 5. Information can also be moved from column to column (left to right across the display) in a column scanning mode. For most applications (5 or more characters to share the same ROM) it is more economical to use row scanning.

A much more detailed description of general scanning techniques along with specific circuit recommendations is contained in HP Application Note 931.

MECHANICAL/THERMAL MOUNTING

The solid state display typically operates with 200 mW power dissipation per character. However, if the operating conditions are such that the power dissipation exceeds the derated maximum allowable value, the device should be heat sunk. The usual mounting technique combines mechanical support and thermal heat sinking in a common structure. A metal strap or bar can be mounted behind the display using silicone grease to insure good thermal control. A well-designed heat sink can limit the case temperature to within 10°C of ambient.

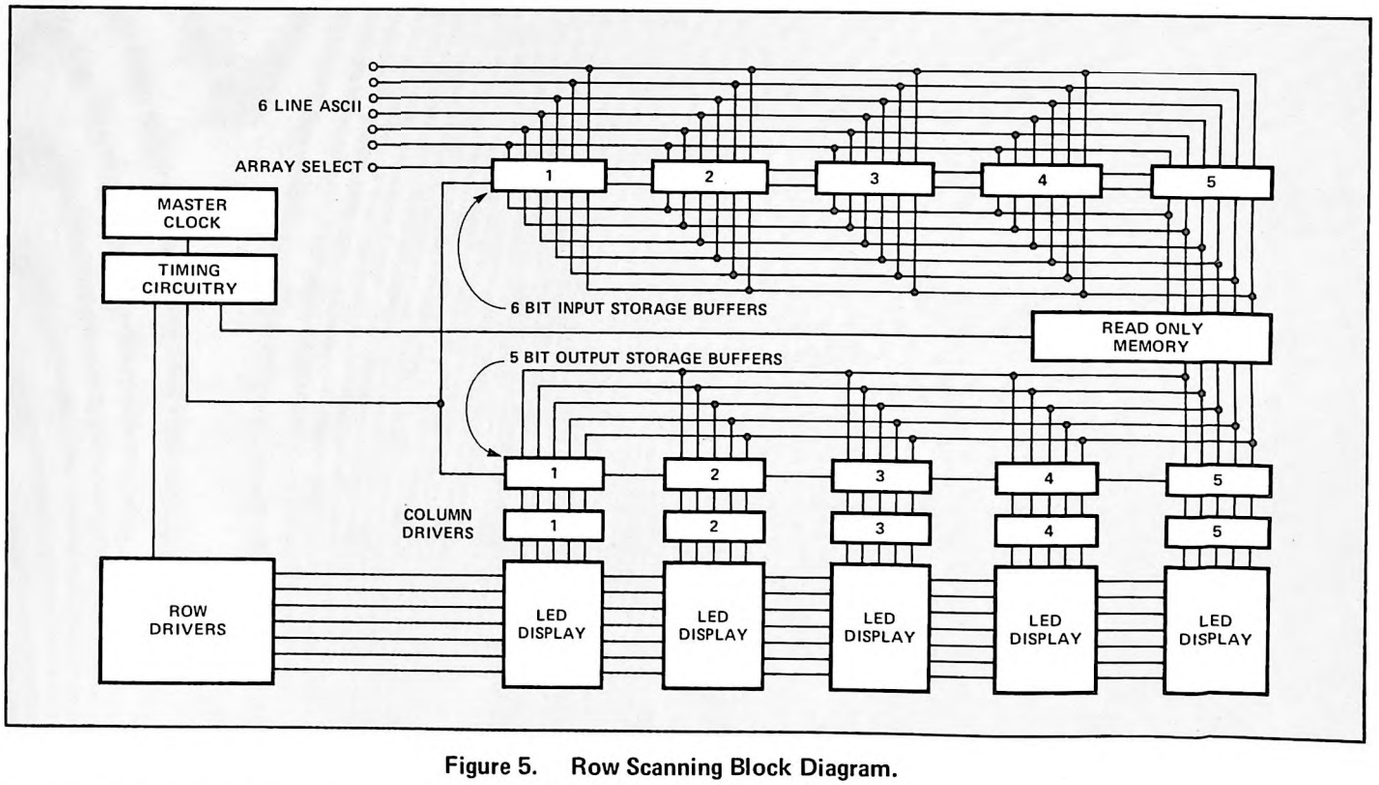
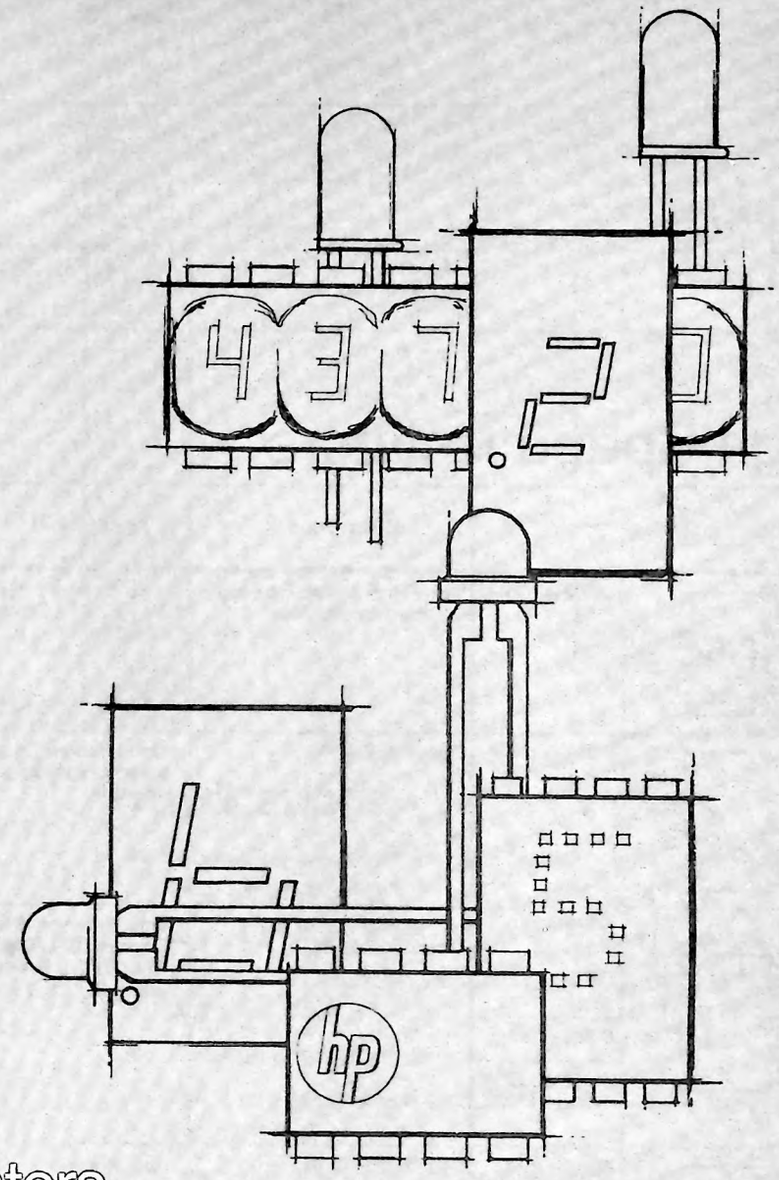


Figure 5. Row Scanning Block Diagram.



Isolators

Selection Guide 86

Low Input Current/High Gain Isolators:

Diode/Transistor/Transistor Isolators, 5082-4370/1 87

High Speed Isolators:

Optically Isolated Gate, 5082-4360 91

Dual Optically Isolated Gate, 5082-4364 95

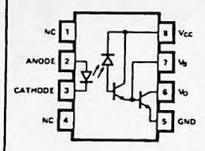
Diode/Transistor Isolators, 5082-4350/1/2 99

Dual Diode/Transistor Isolator, 5082-4354/55 103

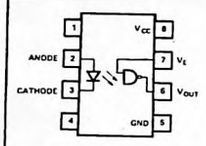
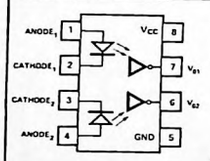
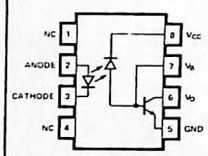
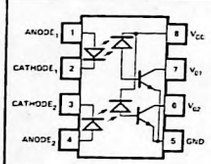
High Reliability Isolator:

Dual Optically Coupled Gate, 5082-4365 (TX, TXB) 107

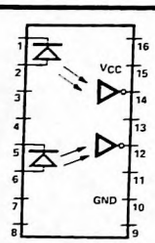
Low Input Current/High Gain Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	5082-4371[2]	Low Input Current, High Gain. V_{CC}=18V Max.	Line Receiver, Ultra Low Current Ground Isolation, CMOS/LTTL CMOS/TTL, CMOS/CMOS	300k bit/s	400% Min.	0.5mA	2500V[4]	87
	5082-4370[2]	Low Input Current, High Gain. V_{CC}=7V Max.	Line Receiver, Low Current, TTL/TTL, LTTL/TTL, CMOS/TTL		300% Min.	1.6mA		

High Speed Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	5082-4360[2]	Ultra High Speed Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	2500V[4]	91
	5082-4364[2]	Dual 5082-4360	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	2500V[4]	95
	5082-4350	High Speed Transistor Output Isolator	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.	16mA	2500V[4]	99
	5082-4351				15% Min.			
	5082-4352				15-22%[3]			
	5082-4354	Dual 5082-4350	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.	16mA	2500V	103
	5082-4355	Dual 5082-4351			15% Min.			

High Reliability Isolator

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	5082-4365[2]	Dual Channel Hermetically Sealed Optically Coupled Logic Gate. TX — Screened TXB — Screened with Grp. B Data	Line Receiver, Ground Isolation for High Reliability Systems	10M bit/s	400% Typ.	10mA	1500V	107
	TX-4365[2]							
	TXB-4365[2]							

NOTES:
1. For further information ask for Application Notes 939, 948 and 951-1. (See page 117.)
2. Performance guaranteed over complete operational temperature range.
3. The 5082-4352 Current Transfer Ratio Specification is guaranteed to be 15% minimum and 22% maximum.
4. U.L. recognized.

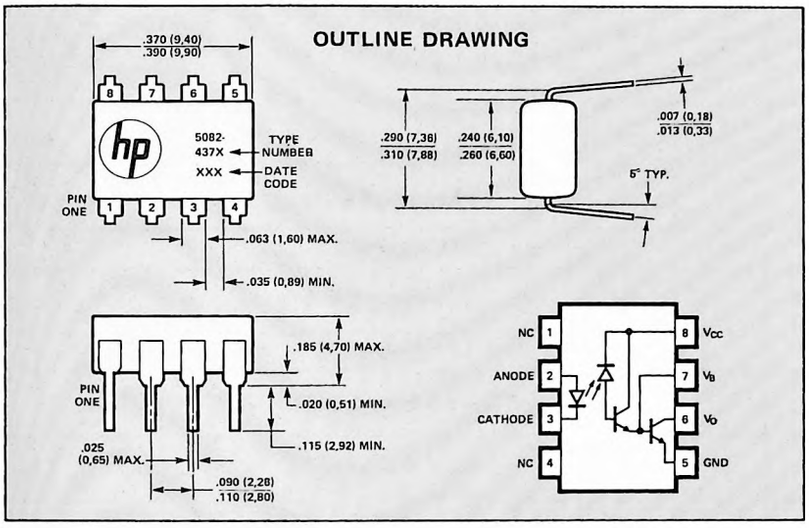
HEWLETT hp PACKARD

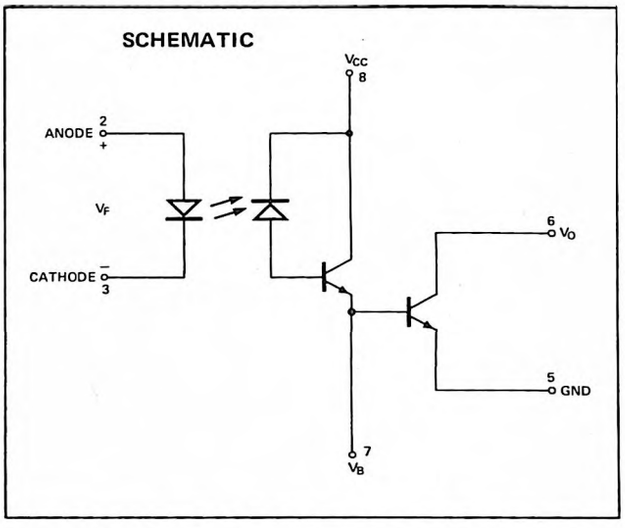
COMPONENTS

LOW INPUT CURRENT, HIGH GAIN OPTICALLY COUPLED ISOLATORS

5082-4370
5082-4371

TECHNICAL DATA JANUARY 1975





Features

- **High Current Transfer Ratio – 800% Typical**
- **Low Input Current Requirement – 0.5 mA**
- **TTL Compatible Output – 0.1V V_{OL}**
- **2500 Vdc Insulation Voltage**
- **High Common Mode Rejection – 500V/μs**
- **Performance Guaranteed Over Temperature 0°C to 70°C**
- **Base Access Allows Gain Bandwidth Adjustment**
- **High Output Current – 60mA**
- **DC to 1M bit/s Operation**
- **Recognized Under the Component Recognition Program of Underwriters Laboratories, Inc.**

Description

The 5082-4370 series isolators use a Light Emitting Diode and an integrated high gain photon detector to provide 2500V dc electrical insulation, 500V/μs common mode transient immunity and extremely high current transfer ratio between input and output. Separate pins for the photodiode and output stage result in TTL compatible saturation voltages and high speed operation. Where desired the V_{CC} and V_O terminals may be tied together to achieve conventional photodarlington operation. A base access terminal allows a gain bandwidth adjustment to be made.

The 5082-4371 is suitable for use in CMOS, LTTL or other low power applications. A 400% minimum current transfer ratio is guaranteed over a 0-70°C operating range for only 0.5mA of LED current.

The 5082-4370 is suitable for use mainly in TTL applications. Current Transfer Ratio is 300% minimum over 0-70°C for an LED current of 1.6mA [1 TTL unit load (U.L.)]. A 300% minimum CTR enables operation with 1 U.L. in, 1 U.L. out with a 2.2 kΩ pull-up resistor.

Applications

- Ground Isolate Most Logic Families – TTL/TTL, CMOS/TTL, CMOS/CMOS, LTTL/TTL, CMOS/LTTL
- Low Input Current Line Receiver – Long Line or Partyline
- EIA RS-232C Line Receiver with 2500V, 60Hz Common Mode Rejection
- Telephone Ring Detector
- 117 V ac Line Voltage Status Indicator – Low Input Power Dissipation
- Low Power Systems – Ground Isolation

Absolute Maximum Ratings

Storage Temperature . . . . . –55°C to +125°C
Operating Temperature . . . . . 0°C to +70°C
Lead Solder Temperature . . . . . 260°C for 10 Sec
(1/16" below seating plane)
Average Input Current – I_F . . . . . 20mA [1]
Peak Input Current – I_F 40mA
(50% duty cycle, 1ms pulse width)
Peak Transient Input Current – I_F 1.0A
($\leq$ 1μsec pulse width, 300pps)
Reverse Input Voltage – V_R 5V
Input Power Dissipation . . . . . 35mW [2]
Output Current – I_O (Pin 6) . . . . . 60mA [3]
Emitter-Base Reverse Voltage (Pin 5-7) 5V
Supply and Output Voltage – V_{CC} (Pin 8-5), V_O (Pin 6-5)
5082-4370 . . . . . –0.5 to 7V
5082-4371 . . . . . –0.5 to 18V
Output Power Dissipation . . . . . 100mW [4]

See notes, page 2.

Electrical Specifications

OVER RECOMMENDED TEMPERATURE (T_A = 0°C to 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device 5082-	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4371	400 500	800 900		%	I_F = 0.5mA, V_O = 0.4V, V_{CC} = 4.5V I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		5,6
		4370	300	600		%	I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		
Logic Low Output Voltage	V_{OL}	4371		0.1 0.1 0.2	0.4 0.4 0.4	V	I_F = 1.6mA, I_O = 6.4mA, V_{CC} = 4.5V I_F = 5mA, I_O = 15mA, V_{CC} = 4.5V I_F = 12mA, I_O = 24mA, V_{CC} = 4.5V		6
		4370		0.1	0.4	V	I_F = 1.6mA, I_O = 4.8mA, V_{CC} = 4.5V		
Logic High Output Current	I_{OH}	4371		0.05	100	μA	I_F = 0mA, V_O = V_{CC} = 18V		6
		4370		0.1	250	μA	I_F = 0mA, V_O = V_{CC} = 7V		
Logic Low Supply Current	I_{CCL}			0.2		mA	I_F = 1.6mA, V_O = Open, V_{CC} = 5V		6
Logic High Supply Current	I_{CCH}			10		nA	I_F = 0mA, V_O = Open, V_{CC} = 5V		6
Input Forward Voltage	V_F			1.4	1.7	V	I_F = 1.6mA, T_A = 25°C		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			−1.8		mV/°C	I_F = 1.6mA		
Input Capacitance	C_O			40		pF	f=1 MHz, V_F = 0		
Insulation Voltage (Input-Output)	V_{I-O}		2500			V dc	45% Relative Humidity, T_A = 25°C		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500 Vdc		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f = 1 MHz		7

*All typicals at T_A = 25°C and V_{CC} = 5V, unless otherwise noted.

Switching Specifications

AT T_A = 25°C

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4371		5 0.2	25 1	μs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270Ω	9	6,8
		4370		1	10	μs	I_F = 1.6mA, R_L = 2.2kΩ		
Propagation Delay Time To Logic High at Output	t_{PLH}	4371		5 1	60 7	μs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270Ω	9	6,8
		4370		4	35	μs	I_F = 1.6mA, R_L = 2.2kΩ		
Common Mode Transient Immunity at Logic High Level Output	CM_H			>500		V/μs	I_F = 0mA, R_L = 2.2kΩ $\|V_{cm}\|$ = 10V_{p-p}	10	9
Common Mode Transient Immunity at Logic Low Level Output	CM_L			<−500		V/μs	I_F = 1.6mA, R_L = 2.2kΩ $\|V_{cm}\|$ = 10V_{p-p}	10	9

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 0.4mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7mW/°C.
3. Derate linearly above 25°C free-air temperature at a rate of 0.7mA/°C.
4. Derate linearly above 25°C free-air temperature at a rate of 2.0mW/°C.
5. DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Pin 7 Open.
7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
8. Use of a resistor between pin 5 and 7 will decrease gain and delay time. See Application Note 951-1 for more details.
9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm}, to assure that the output will remain in a Logic High state (i.e., V_O > 2.0V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm}, to assure that the output will remain in a Logic Low state (i.e., V_O < 0.8V).

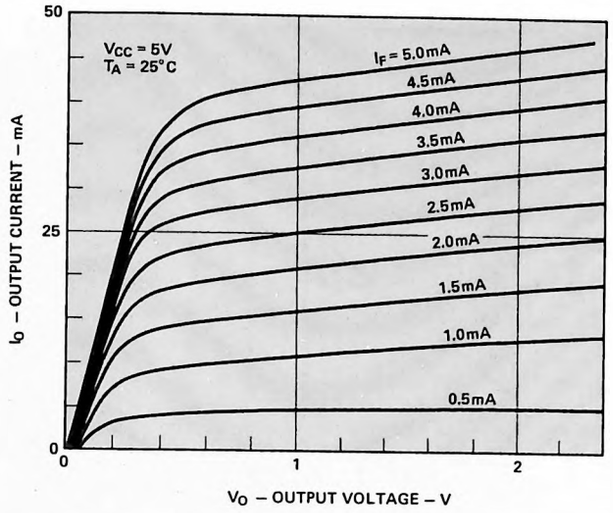


Figure 1. 5082-4371 DC Transfer Characteristics.

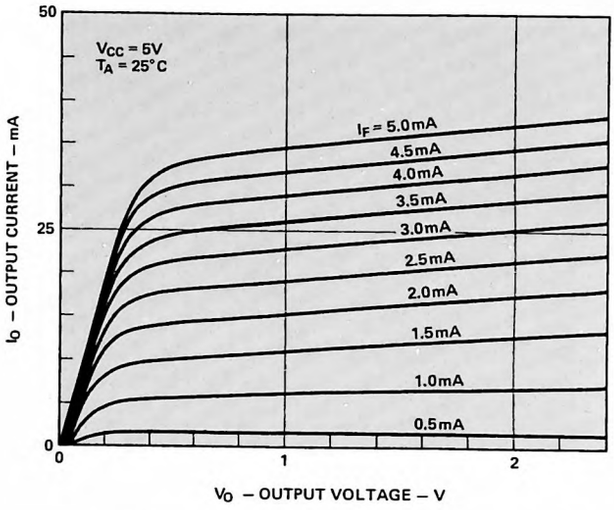


Figure 2. 5082-4370 DC Transfer Characteristics.

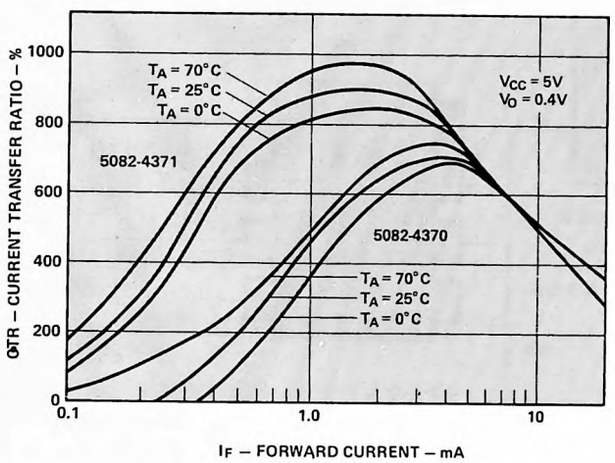


Figure 3. Current Transfer Ratio vs. Forward Current.

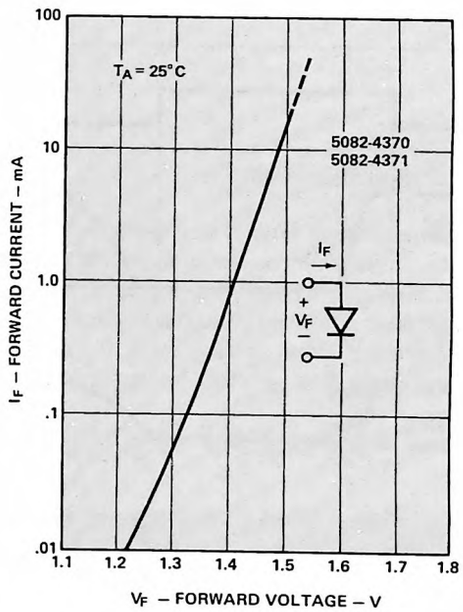


Figure 4. Input Diode Forward Current vs. Forward Voltage.

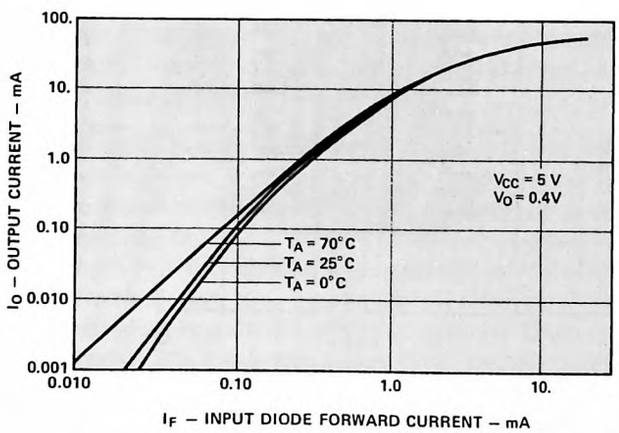


Figure 5. 5082-4371 Output Current vs. Input Diode Forward Current.

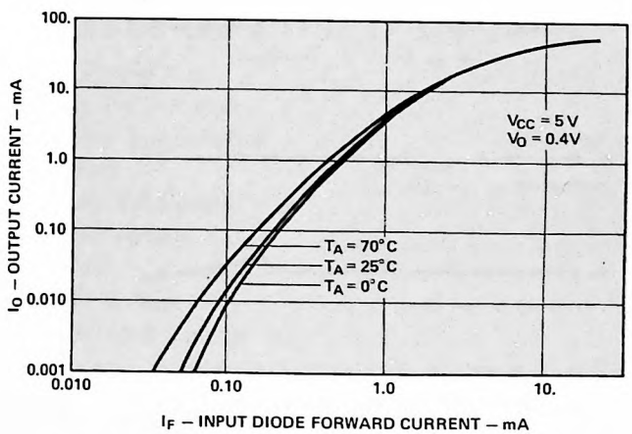


Figure 6. 5082-4370 Output Current vs. Input Diode Forward Current.

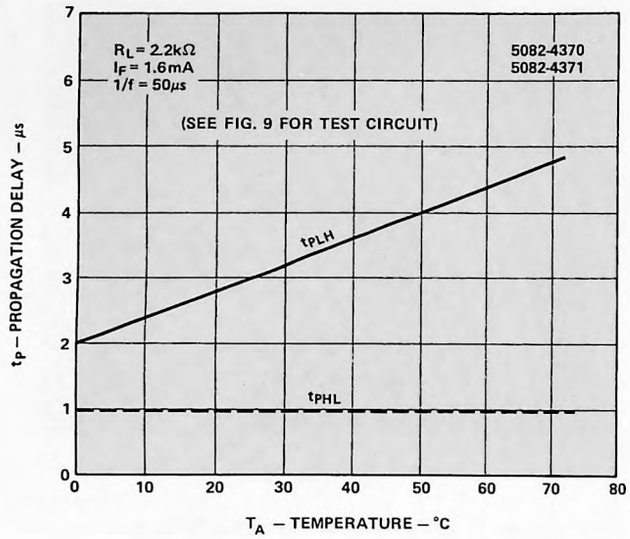


Figure 7. Propagation Delay vs. Temperature.

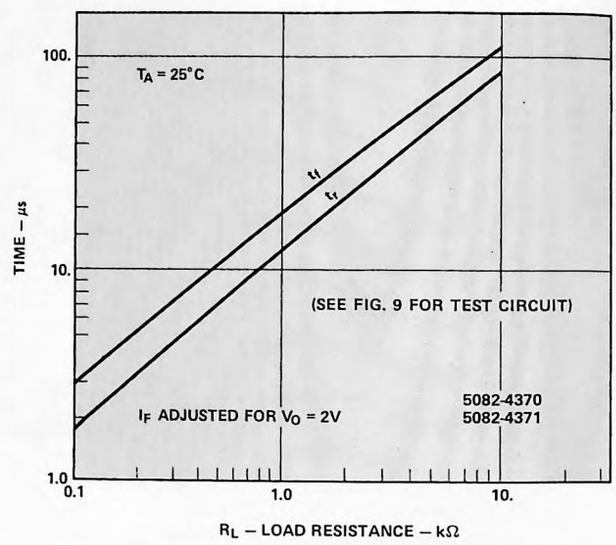


Figure 8. Non Saturated Rise and Fall Times vs. Load Resistance.

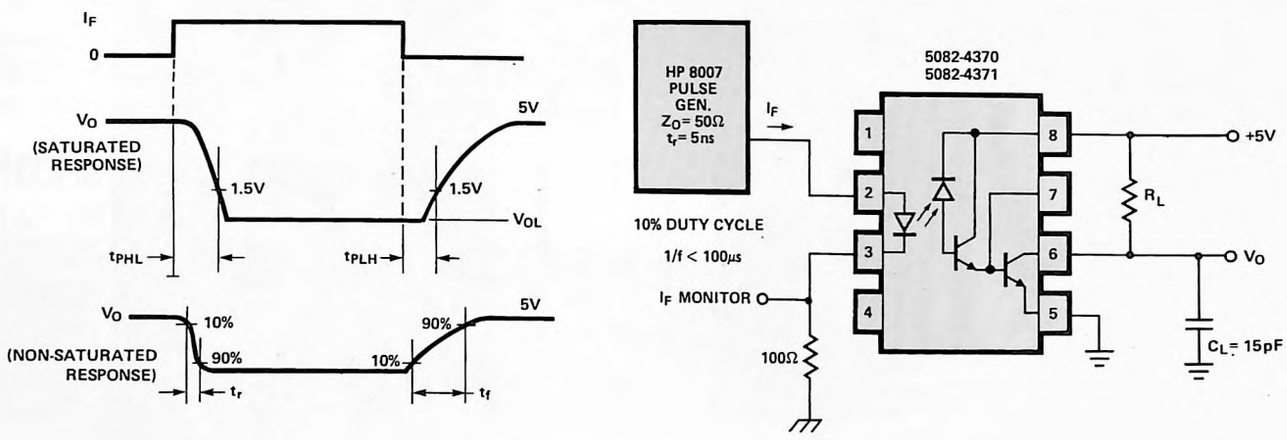


Figure 9. Switching Test Circuit.

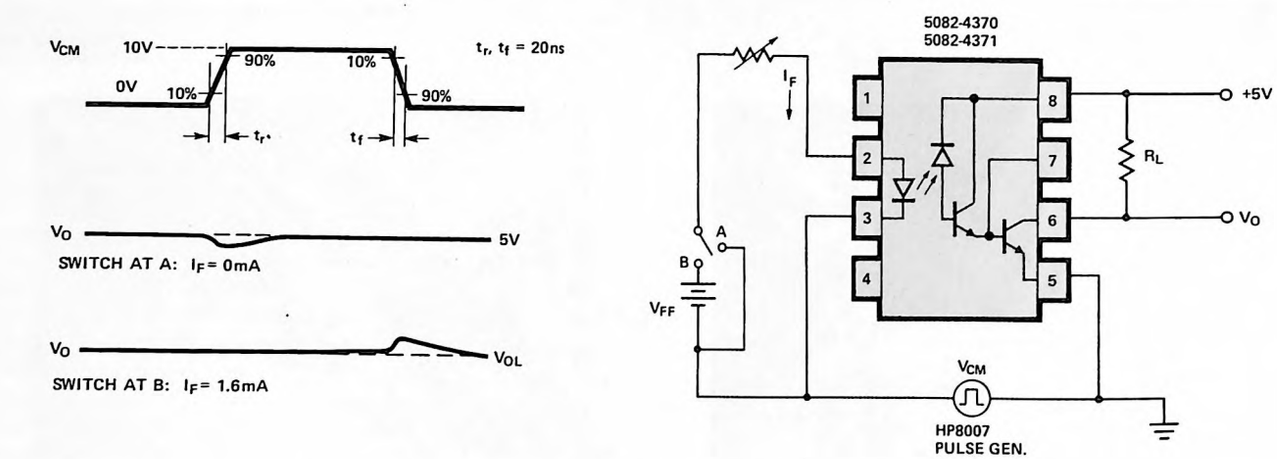


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

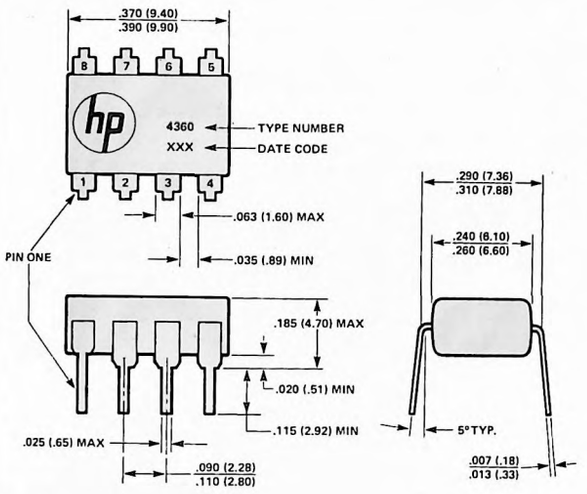
HEWLETT hp PACKARD

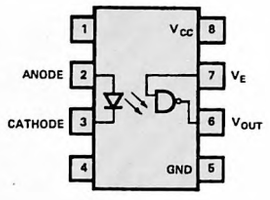
COMPONENTS

DTL/TTL COMPATIBLE OPTICALLY ISOLATED GATE

5082-4360

TECHNICAL DATA JANUARY 1975





TRUTH TABLE (Positive Logic)

Input*	Enable	Output
1	1	0
0	1	1
1	0	1
0	0	1

* See definition of terms for logic state.

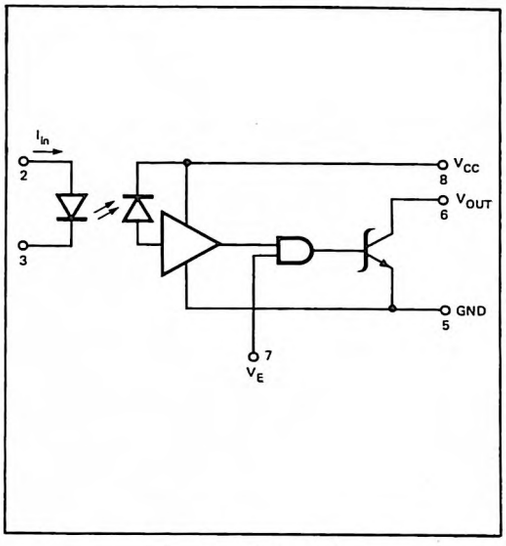


Figure 1. Schematic

Features

- DTL/TTL COMPATIBLE – 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQ. – 5mA
- HIGH COMMON MODE REJECTION – 20V @ 1 MHz
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC.

Description/Applications

The 5082-4360 optical isolated gate combines a GaAsP diode that emits photons proportional to its forward current and a unique integrated detector. The photons are collected in the detector by a photo diode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. The circuit is temperature, current and voltage compensated. The output circuit also has a DTL type enable input to provide strobing of the detector.

This unique isolator design provides maximum DC and AC circuit isolation between input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5 mA will sink an eight gate fan-out (13 mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a propagation delay of 50 nsec. The enable input provides gating of the detector with input sinking and sourcing requirements compatible with DTL/TTL interfacing and a propagation delay of 30 nsec typical.

The 5082-4360 can be used in high speed digital interface applications where common mode signals must be rejected; such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished between system interfaces such as a computer and a peripheral memory. The open collector in combination with the enable input provides capability for bussing, OR'ing, and strobing.

Recommended Operating Conditions

	Min.	Nom.	Max.	Units
Input Current - I_{in}	0		10	mA
Supply Voltage - V_{CC}	4.5	5.0	5.5	V
Fan-Out - N (TTL Load)			8	–
Operating Temperature Range - T_A	0	25	70	°C

Absolute Maximum Ratings

Storage Temperature . . . . . –55°C to +125°C
Operating Temperature . . . . . 0°C to +70°C
Lead Solder Temperature . . . . . 260°C for 10 Sec.
Input Diode
  Forward DC Current 10mA
  Reverse Voltage 5V
Output - IC
  Supply Voltage - V_{CC} 7V
  Enable Input Voltage - V_E 5.5V
    (Not to exceed V_{CC} by more than 500mV)
  Output Collector Current - I_{OUT} 50mA
  Output Collector Power Dissipation 85mW
  Output Collector Voltage - V_{OUT} 7V
Insulation Voltage (Input-Output) 2500V

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE (T_A = 0°C – 70°C)

Parameter	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
I_{in}(1): Logic (1) Input Current to Ensure Logic (0) Output	5			mA		3,4	–
I_{in} (0): Logic (0) Input Current to Ensure Logic (1) Output			250	μA		3,4	–
V_E(1): Logic (1) Enable Voltage	2.0			V		–	–
V_E (0): Logic (0) Enable Voltage			0.8	V		–	–
I_{out}(1): Logic (1) Output Current		50	250	μA	V_{CC} = 5.5V, V_{out} = 5.5V, V_E = 2.0V, I_{in} = 250μA	6	–
V_{out} (0): Logic (0) Output Voltage		0.5	0.6	V	V_{CC} = 5.5V, V_E = 2.0V, I_{in} = 5mA, I_{out} (Sinking) = 13mA	5	–
I_E(0): Logic (0) Enable Current		–1.6	–2.0	mA	V_{CC} = 5.5V, V_E = 0.5V	–	–
I_E(1): Logic (1) Enable Current		–1.0		mA	V_{CC} = 5.5V, V_E = 2.0V	–	–
I_{CC}(1): Logic (1) Supply Current		7	10	mA	V_{CC} = 5.5V, V_E = 0.5V, I_{in} = 0	–	–
I_{CC}(0): Logic (0) Supply Current		13	18	mA	V_{CC} = 5.5V, V_E = 0.5V, I_{in} = 10mA	–	–

*All typical values are at V_{CC} = 5V, T_A = 25°C

Switching Characteristics at T_A=25°C, V_{CC}=5V

Parameter	Min.	Typ.	Max.	Units	Test Condtions	Figure	Note
t_{pd}(1): Propagation Delay Time to Logical (1) Level		45	75	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5mA	7,9	1
t_{pd}(0): Propagation Delay Time to Logical (0) Level		45	75	ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5mA	7,9	2
t_R, t_F: Output Rise, Fall Time (10-90%)		25		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5mA	–	–
t_E(1): Propagation Delay Time of Enable from V_E (1) to V_E (0)		25		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5mA V_E (1) = 2V, V_E (0) = 0.5V	8	3
t_E(0): Propagation Delay Time of Enable from V_E (0) to V_E (1)		15		ns	R_L = 350Ω, C_L = 15pF, I_{in} = 7.5mA V_E (1) = 2V, V_E (0) = 0.5V	8	4

Electrical Characteristics - Input-Output at T_A=25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Insulation Voltage (Input-Output)	BV_{I-O}	2500			V		–	5
Resistance (Input-Output)	R_{I-O}	10^{12}			Ω	V_{I-O} = 500V	–	5
Capacitance (Input-Output)	C_{I-O}		0.6	0.8	pF	f = 1MHz	–	5
Common Mode Rejection Voltage to Logical (0) Level	CMRV (1)		20		VAC p-p	f=1MHz, R_L = 350Ω, V_{out} (min.)=2V, I_{in} = 0mA	11	6
Common Mode Rejection Voltage to Logical (1) Level	CMRV (0)		60		VAC p-p	f = 1MHz, R_L = 350Ω, V_{out} (max.)=0.6V, I_{in} = 7.5mA	11	6
Current Transfer Ratio	CTR		600		%	I_{in} = 5.0mA, V_{CC} = 5V, R_L = 100Ω	2	7

Electrical Characteristics - Input Diode at T_A=25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Forward Voltage	V_F	1.2	1.5	1.75	V	I_{in} = 10mA	4	8
Reverse Breakdown Voltage	V_{BR}	5			V	I_R= 10μA	–	–
Capacitance	C_{in}		40		pF	V_F = 0, f = 1MHz	–	–

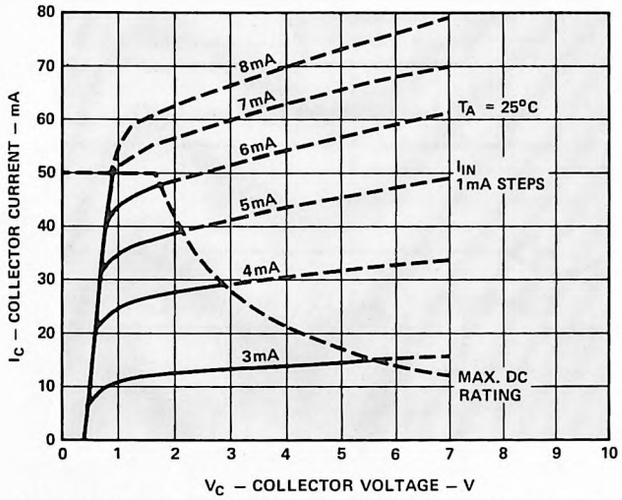
Operating Procedures and Definitions

Logic Convention. The 5082-4360 is defined in terms of positive logic.

Bypassing. A ceramic capacitor (.01μF min.) should be connected from pin 8 to pin 5. Its purpose is to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching properties.

Polarities. All voltages are referenced to network ground (pin 5). Current flowing toward a terminal is considered positive.

Enable Input. No external pull-up required for a logic (1), i.e., can be open circuit.



Note: Dashed characteristics — denote pulsed operation only.

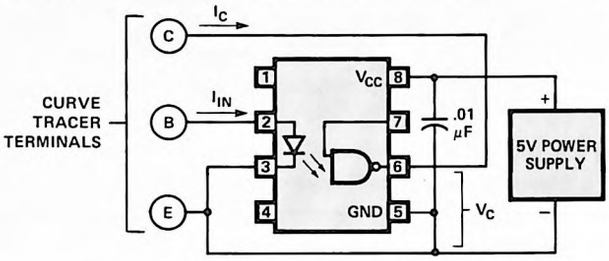
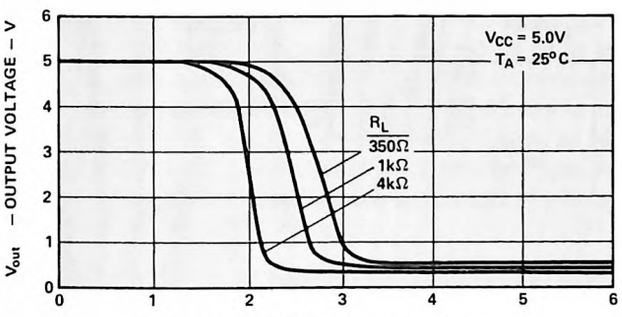


Figure 2. Isolator Collector Characteristics.



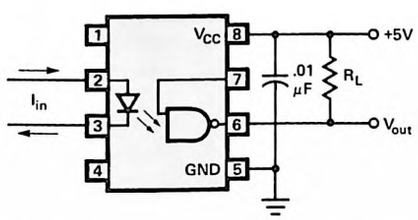


Figure 3. Input-Output Characteristics.

NOTES:

1. The $t_{pd}(1)$ propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The $t_{pd}(0)$ propagation delay is measured from the 3.75 mA point on the input pulse to the 1.5V point on the leading edge of the output pulse.
3. The $t_E(1)$ enable propagation delay is measured from the 1.5V point of the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
4. The $t_E(0)$ enable propagation delay is measured from the 1.5V point on the input pulse to the 1.5V point on the leading edge of the output pulse. The input diode is DC biased to 10 mA [$I_{in}(1)$].
5. Device considered a two terminal device: pins 2 and 3 shorted together, and pins 5, 6, 7, and 8 shorted together.
6. CMRV (1) is the max. tolerable common mode voltage to assure that the output will remain in a logic (1) state (i.e. $V_{out} > 2.0V$). CMRV (0) is the max. tolerable common mode voltage to assure that the output will remain in a logic (0) state (i.e. $V_{out} < 0.6V$).
7. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
8. At 10 mA V_F decreases with increasing temperature at the rate of 1.6 mV/°C.

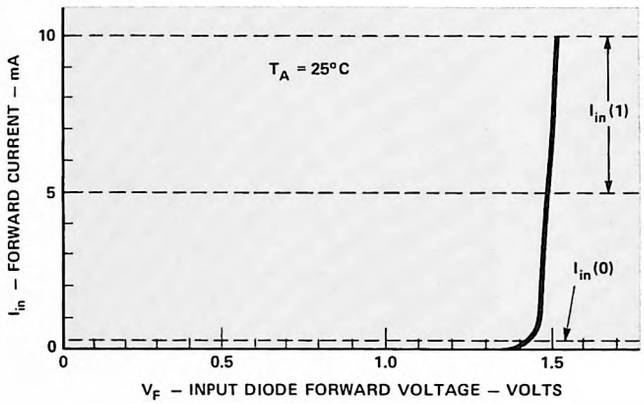


Figure 4. Input Diode Forward Characteristic.

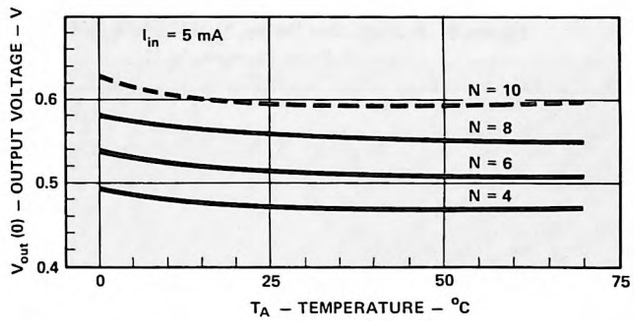


Figure 5. Output Voltage, $V_{OUT}(0)$ vs. Temperature and Fan-Out.

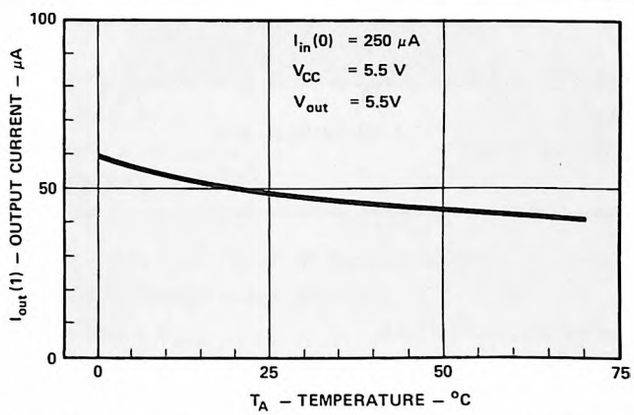


Figure 6. Output Current, $I_{OUT}(1)$ vs. Temperature (I_{in}=250 μA).

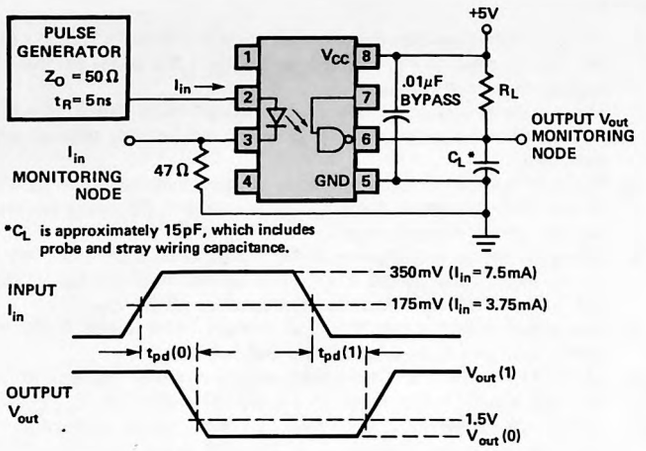


Figure 7. Test Circuit for $t_{pd}(0)$ and $t_{pd}(1)$.

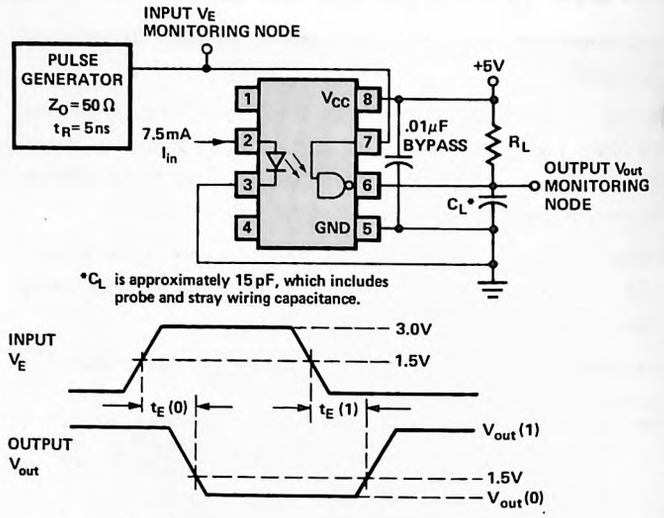


Figure 8. Test Circuit for $t_E(0)$ and $t_E(1)$.

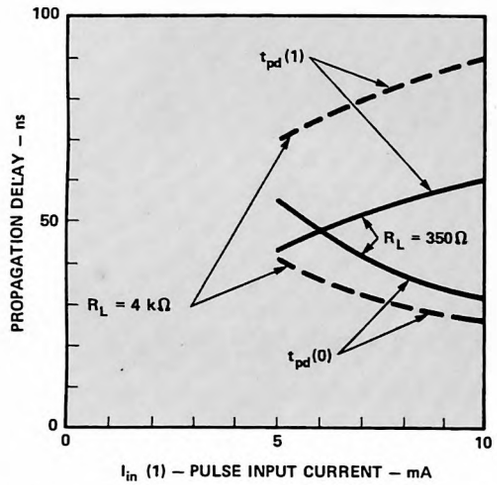


Figure 9. Propagation Delay, $t_{pd}(0)$ and $t_{pd}(1)$ vs. Input Pulse Current, $I_{in}(1)$.

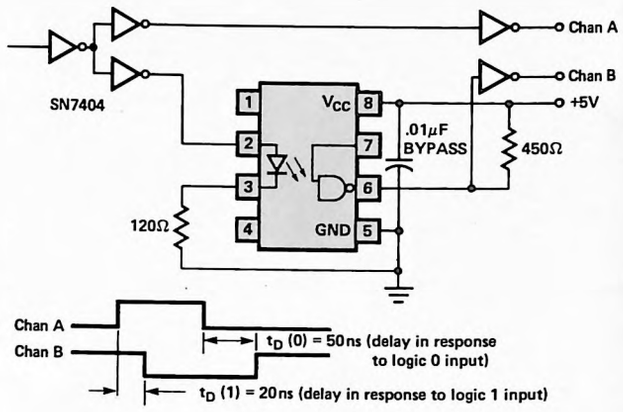
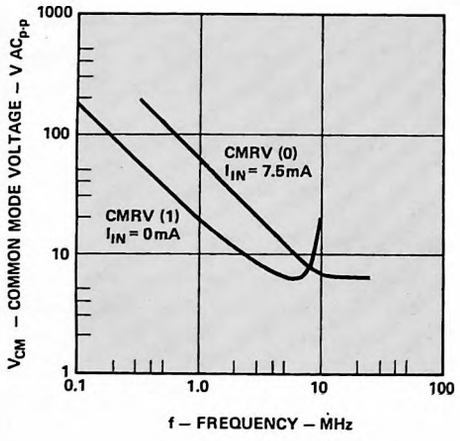


Figure 10. Response Delay Between TTL Gates.



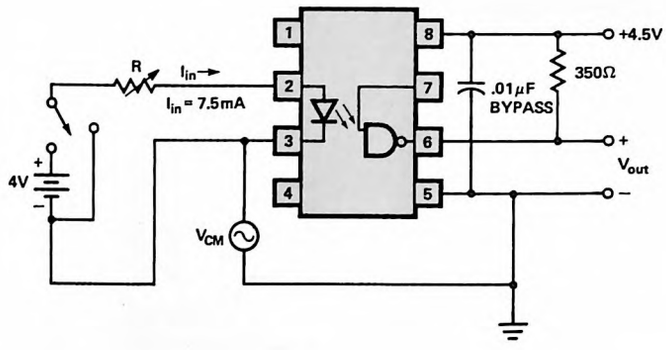


Figure 11. Typical Common Mode Rejection Characteristics/Circuit

HEWLETT PACKARD
COMPONENTS

DUAL DTL/TTL COMPATIBLE OPTICALLY ISOLATED GATE

5082-4364

TECHNICAL DATA JANUARY 1975

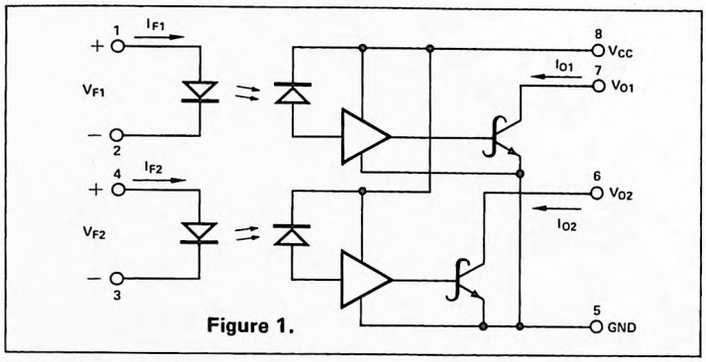


Figure 1.

Features

- HIGH DENSITY PACKAGING
- DTL/TTL COMPATIBLE – 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQ. – 5mA
- HIGH COMMON MODE REJECTION – 20V @ 1 MHz
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC.

Description/Applications

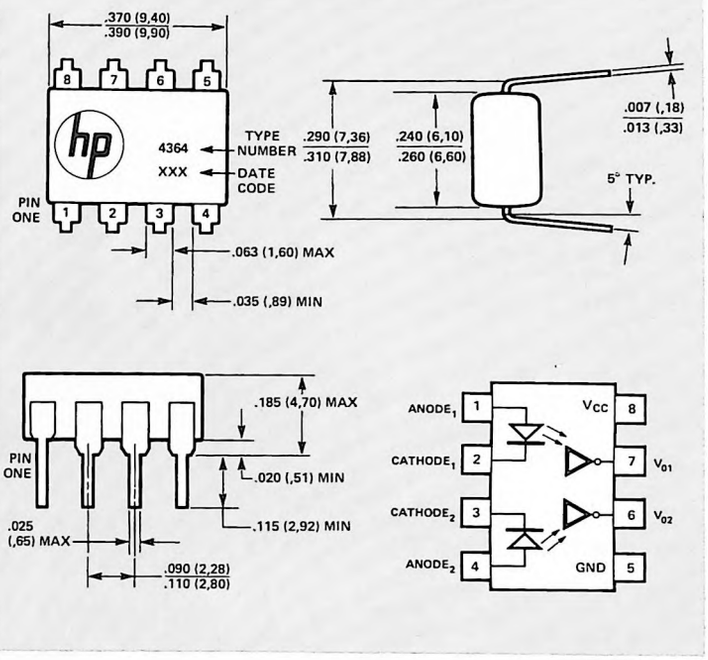
The 5082-4364 consists of a pair of inverting optically isolated gates each with a GaAsP photon emitting diode and a unique integrated detector. The photons are collected in the detector by a photodiode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. Each circuit is temperature, current and voltage compensated.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5 mA in each channel will sink an eight gate fan-out (13 mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 50 nsec.

The 5082-4364 can be used in high speed digital interface applications where common mode signals must be rejected such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished between system interfaces such as a computer and a peripheral memory.

The open collector output provides capability for bussing, OR'ing, and strobing. In all applications, the dual channel configuration allows for high density packaging, increased convenience and more usable board space.

PIN CONNECTION DIAGRAM



Recommended Operating Conditions

	Sym.	Min.	Typ.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0		250	μA
Input Current, High Level Each Channel	I_{FH}	5	7.5	10	mA
Supply Voltage, Output	V_{CC}	4.5	5.0	5.5	V
Fan Out (TTL Load) Each Channel	N			8	
Operating Temperature	T_A	0	25	70	°C

Absolute Maximum Ratings

Storage Temperature . . . . . −55°C to +125°C
Operating Temperature . . . . . 0°C to +70°C
Lead Solder Temperature . . . . . 260°C for 10 Sec.
Peak Forward Input Current (each channel) . . . . 20 mA (≤ 1 msec Duration)
Average Forward Input Current (each channel) . . . 10 mA
Reverse Input Voltage (each channel) 5V
Supply Voltage - V_{CC} . . . . . 7V (1 Minute Maximum)
Output Current - I_O (each channel) . . . . . 16 mA
Output Voltage - V_O (each channel) 7V

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE (T_A = 0°C – 70°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	No
High Level Output Current	I_{OH}		50	250	μA	V_{CC} = 5.5V, V_O = 5.5V, I_F = 250μA		3
Low Level Output Voltage	V_{OL}		0.5	0.6	V	V_{CC} = 5.5V, I_F = 5mA I_{OL} (Sinking) = 13mA		3
High Level Supply Current	I_{CCH}		14	20	mA	V_{CC} = 5.5V, I_F = 0 Each Channel		
Low Level Supply	I_{CCL}		26	36	mA	V_{CC} = 5.5V, I_F = 10mA Each Channel		
Insulation Voltage Rating (Input-Output)	V_{I-O}	2500			V_{dc}	Relative Humidity = 45% T_A = 25°C		4
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O} = 500V, T_A = 25°C		4
Capacitance (Input-Output)	C_{I-O}		0.6		pF	f = 1MHz, T_A = 25°C		4
Input Forward Voltage	V_F		1.5	1.75	V	I_F = 10mA, T_A = 25°C	4	7,3
Input Reverse Breakdown Voltage	BV_R	5			V	I_R = 10μA, T_A = 25°C		
Input Capacitance	C_{in}		40		pF	V_F = 0, f = 1MHz		3
Insulation Voltage (Input-Input)	V_{I-I}		1500		V	Relative Humidity = 45%		8
Resistance (Input-Input)	R_{I-I}		10^{11}		Ω	$V_{I(1-2)}$ = 500V		8
Capacitance (Input-Input)	C_{I-I}		0.25		pF	f = 1MHz		8
Current Transfer Ratio	CTR		600		%	I_F = 5.0mA, R_L = 100Ω	2	

*All typical values are at V_{CC} = 5V, T_A = 25°C

Switching Characteristics at T_A=25°C, V_{CC}=5V

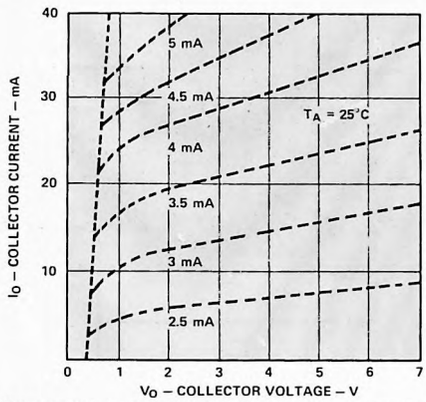
EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		55	75	ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA	5,6	1
Propagation Delay Time to Low Output Level	t_{PHL}		40	75	ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA	5,6	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA		
Common Mode Rejection Voltage at High Output Level	$CMRV_H$		20		$V_{ac\ p\text{-}p}$	f = 1MHz, R_L = 350 Ω, V_O (min.) = 2V, I_F = 0mA	8	5
Common Mode Rejection Voltage at Low Output Level	$CMRV_L$		60		$V_{ac\ p\text{-}p}$	f = 1MHz, R_L = 350 Ω, V_O (max.) = 0.6V, I_F = 7.5mA	8	5

NOTE: It is essential that a by-pass capacitor (.01 μF minimum, ceramic) be connected from pin 8 to pin 5, as close to the device as possible. Failure to provide the by-pass may impair the switching properties.

NOTES:

1. The t_{PLH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
3. Each channel.
4. Measured between pins 1, 2, 3, and 4 shorted together, and pins 5, 6, 7, and 8 shorted together.
5. $CMRV_H$ is the max. tolerable common mode voltage to assure that the output will remain in a high logic state (i.e. $V_O > 2.0V$). $CMRV_L$ is the max. tolerable common mode voltage to assure that the output will remain in a low logic state (i.e. $V_O < 0.6V$).
6. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
7. At 10mA V_F decreases with increasing temperature at the rate of 1.9mV/°C.
8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.



NOTE: Dashed characteristics indicate pulsed operation.

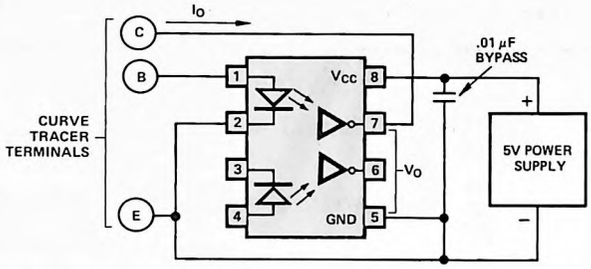
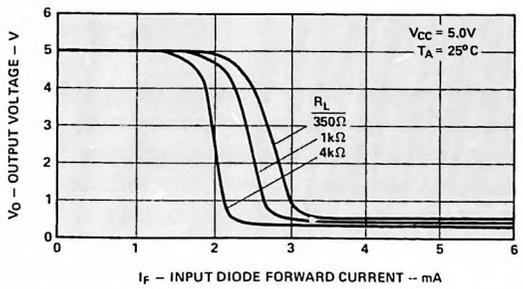


Figure 2. Isolator Transfer Characteristics.



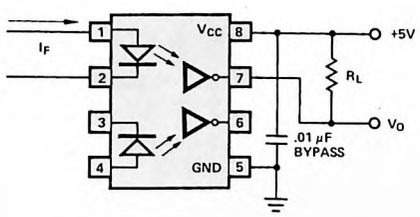


Figure 3. Input-Output Characteristics.

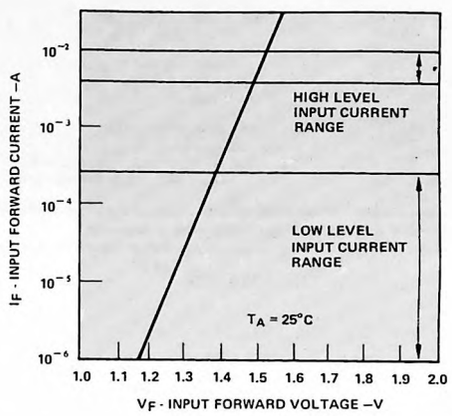
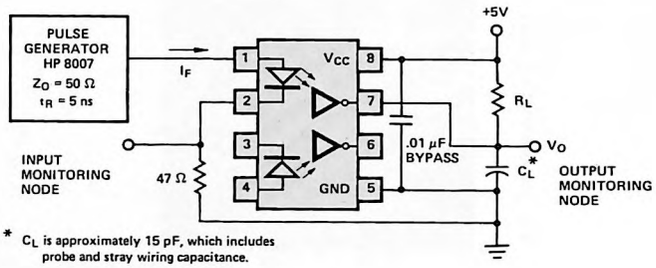


Figure 4. Input Diode Forward Characteristic



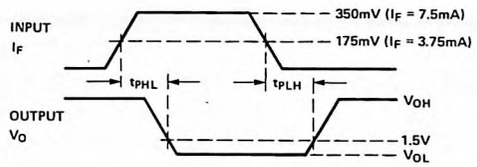


Figure 5. Test Circuit for t_{PHL} and t_{PLH}.

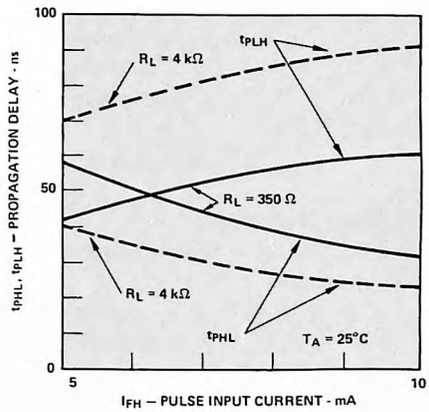


Figure 6. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}.

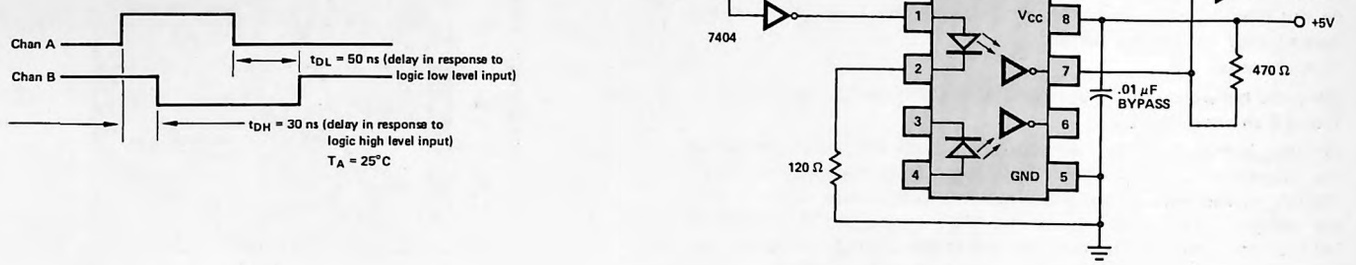


Figure 7. Response Delay Between TTL Gates.

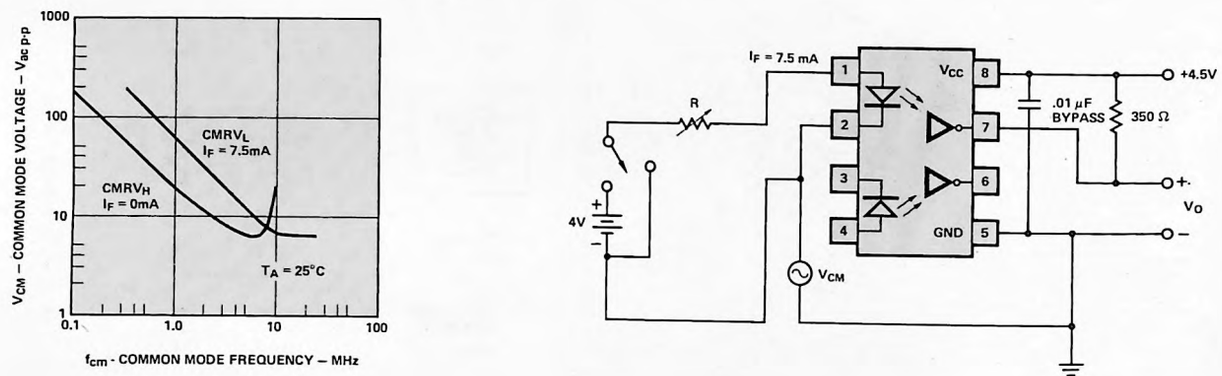


Figure 8. Typical Common Mode Rejection Characteristics/Circuit

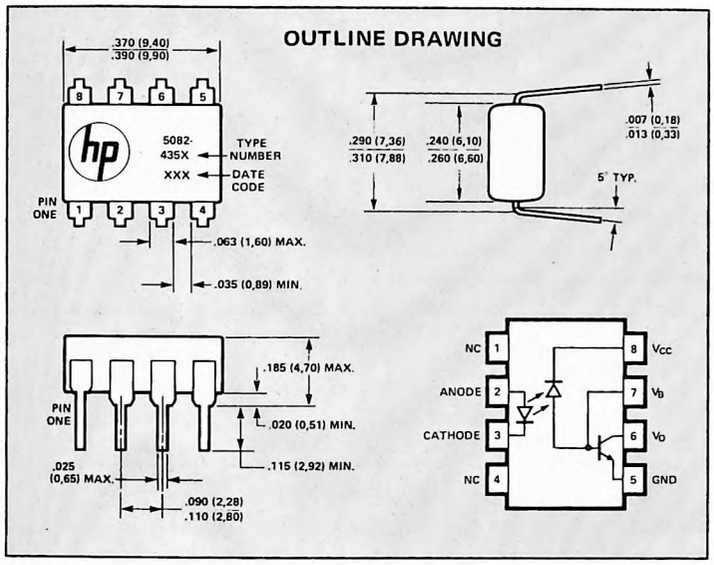
HEWLETT hp PACKARD

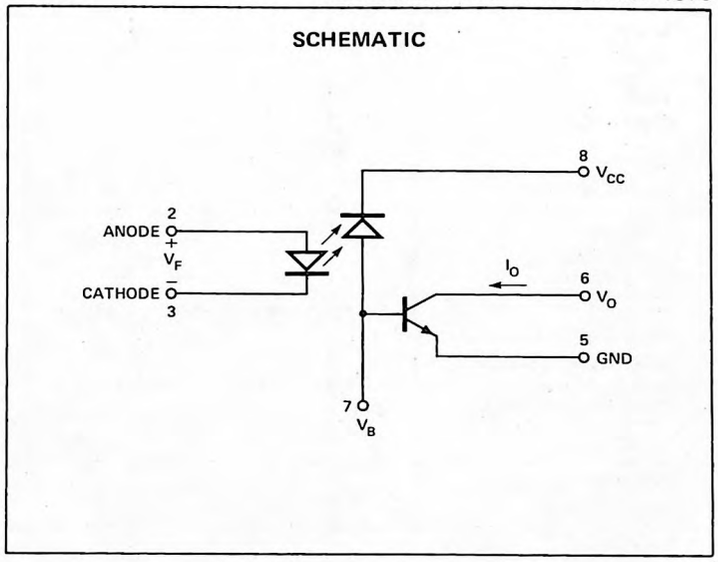
COMPONENTS

HIGH SPEED OPTICALLY COUPLED ISOLATORS

5082-4350
5082-4351
5082-4352

TECHNICAL DATA JANUARY 1975





Features

- **High Speed — 1Mbit/s**
- **TTL Compatible**
- **Recognized Under the Component Program of Underwriters Laboratories, Inc.**
- **High Common Mode Transient Immunity — >1000V/μs**
- **2500V dc Insulation Voltage**
- **2 MHz Bandwidth**
- **Open Collector Output**

Description

The 5082-4350 series isolators use a light emitting diode and an integrated photon detector to provide 2500V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collector improve the speed up to a hundred times that of a conventional phototransistor isolator by reducing the base-collector capacitance.

The 5082-4350 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -4350 is 7% minimum for I_F = 16 mA.

The 5082-4351 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6 kΩ pull-up resistor. CTR of the -4351 is 15% minimum at I_F = 16 mA.

The 5082-4352 is suitable for use in applications where matched or known CTR is desired. CTR is 15 to 22% at I_F = 16 mA.

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/μs) allows use of low cost twisted pair cable instead of coax.
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS.
- **Replace Slow Phototransistor Isolators** — Pins 2-7 of the -4350 series conform to pins 1-6 of 6 pin phototransistor isolators. Pin 8 can be tied to any available bias voltage of 1.5V to 15V for high speed operation.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.

Absolute Maximum Ratings

Storage Temperature	-55°C to +125°C
Operating Temperature	-55°C to 100°C
Lead Solder Temperature	260°C for 10Sec (1/16" below seating plane)
Average Input Current — I_F	25mA[1]
Peak Input Current — I_F	50mA[2] (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F	1.0A (≤1μsec pulse width, 300pps)
Reverse Input Voltage — V_R (Pin 3-2)	5V
Input Power Dissipation	45mW[3]
Average Output Current — I_O (Pin 6)	8mA
Peak Output Current	16mA
Emitter-Base Reverse Voltage (Pin 5-7)	5V
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 6-5)	-0.5V to 15V
Base Current — I_B (Pin 7)	5mA
Output Power Dissipation	100mW[4]

See notes, page 2.

Electrical Specifications ($T_A = 25°C$)

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4350	7	18		%	I_F = 16mA, V_O = 0.4V, V_{CC} = 4.5V	2	5
		4351	15	22		%			
		4352	15		22	%			
Logic Low Output Voltage	V_{OL}	4350		0.1	0.4	V	I_F = 16mA, I_O = 1.1mA, V_{CC} = 4.5V		
		4351, 4352		0.1	0.4	V	I_F = 16mA, I_O = 2.4mA, V_{CC} = 4.5V		
Logic High Output Current	I_{OH}			3	500	nA	I_F = 0mA, V_O = V_{CC} = 5.5V	6	
Logic High Output Current	I_{OH}				100	μA	I_F = 0mA, V_O = V_{CC} = 15V		
Logic Low Supply Current	I_{CCL}			16		μA	I_F = 16mA, V_O = Open, V_{CC} = 15V		
Logic High Supply Current	I_{CCH}			0.02	1	μA	I_F = 0mA, V_O = Open, V_{CC} = 15V		
Input Forward Voltage	V_F			1.5	1.7	V	I_F = 16mA	3	
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I_F = 16mA		
Input Reverse Voltage	V_R		5			V	I_R = 10μA		
Input Capacitance	C_O			40		pF	f = 1MHz, V_F = 0		
Insulation Voltage (Input-Output)	V_{I-O}		2500			V dc	45% Relative Humidity		6
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500V dc		6
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f = 1MHz		6
Transistor DC Current Gain	h_{FE}			150		—	V_O = 5V, I_O = 3mA		

Switching Specifications ($T_A = 25°C$)

V_{CC} = 5V, I_F = 16mA UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4350		0.5	1.5	μs	R_L = 4.1kΩ	5,9	8,9
		4351, 4352		0.2	0.8	μs	R_L = 1.9kΩ		
Propagation Delay Time To Logic High at Output	t_{PLH}	4350		0.4	1.0	μs	R_L = 4.1kΩ	5,9	8,9
		4351, 4352		0.3	0.8	μs	R_L = 1.9kΩ		
Common Mode Transient Immunity at Logic High Level Output	CM_H	4350		>1000		V/μs	I_F = 0mA, V_{CM} = 10V_{P-P}, R_L = 4.1kΩ	10	7,8,9
		4351, 4352		>1000		V/μs	I_F = 0mA, V_{CM} = 10V_{P-P}, R_L = 1.9kΩ		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	4350		<-1000		V/μs	V_{CM} = 10V_{P-P}, R_L = 4.1kΩ	10	7,8,9
		4351, 4352		<-1000		V/μs	V_{CM} = 10V_{P-P}, R_L = 1.9kΩ		
Bandwidth	BW			2		MHz	R_L = 100Ω	8	10

NOTES:
1. Derate linearly above 70°C free-air temperature at a rate of 0.8mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 2.0mW/°C.
5. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
7. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
8. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and a 5.6kΩ pull-up resistor.
9. The 4.1kΩ load represents 1 LTTL unit load of 0.18mA and a 5.6kΩ pull-up resistor.
10. The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.

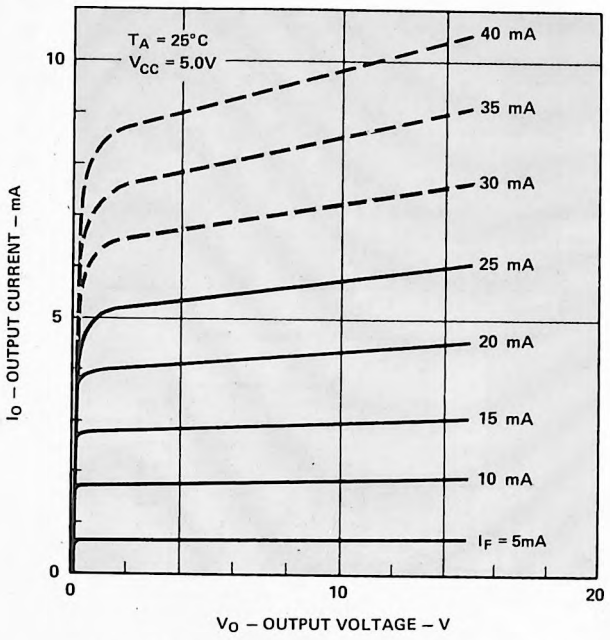


Figure 1. DC and Pulsed Transfer Characteristics.

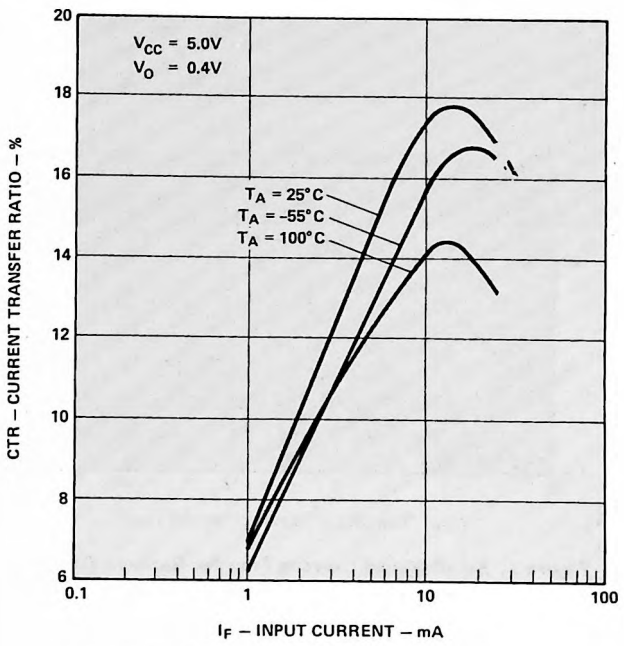


Figure 2. Current Transfer Ratio vs. Input Current.

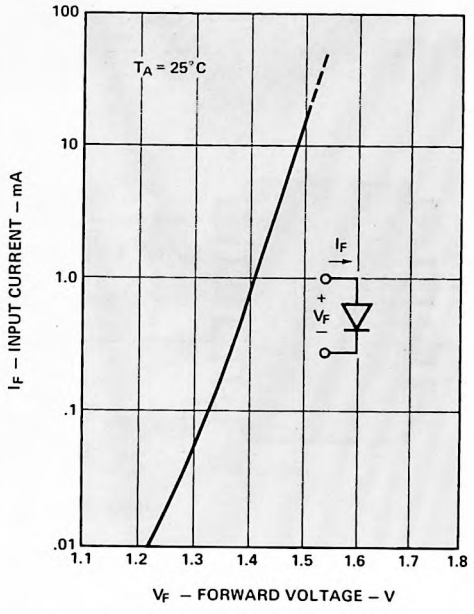


Figure 3. Input Current vs. Forward Voltage.

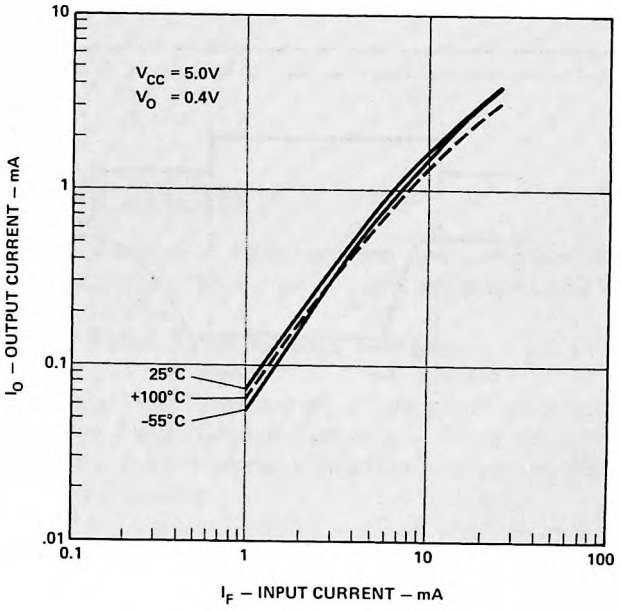


Figure 4. Output Current vs. Input Current.

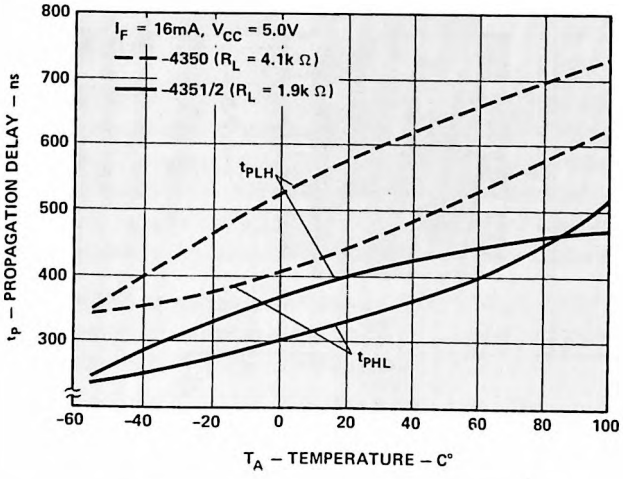


Figure 5. Propagation Delay vs. Temperature.

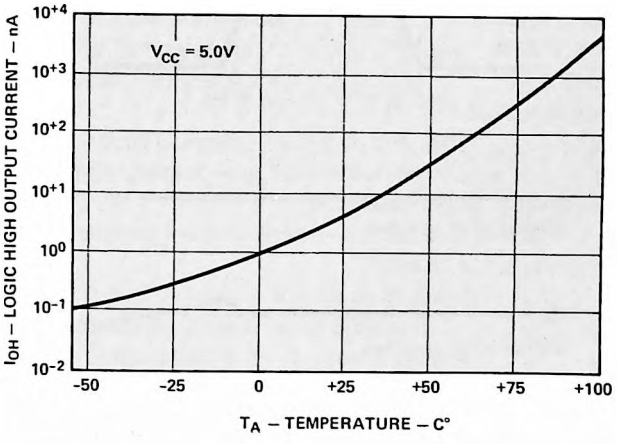


Figure 6. Logic High Output Current vs. Temperature.

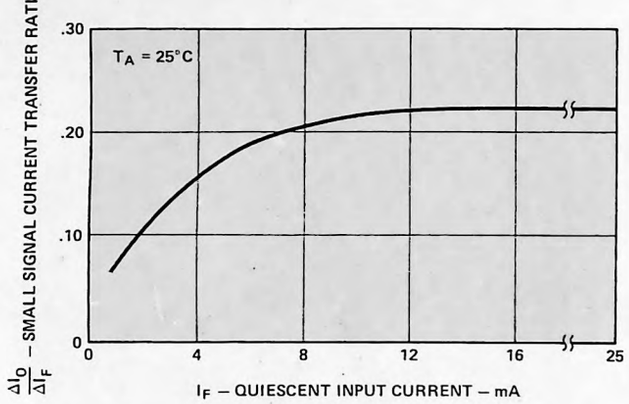


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

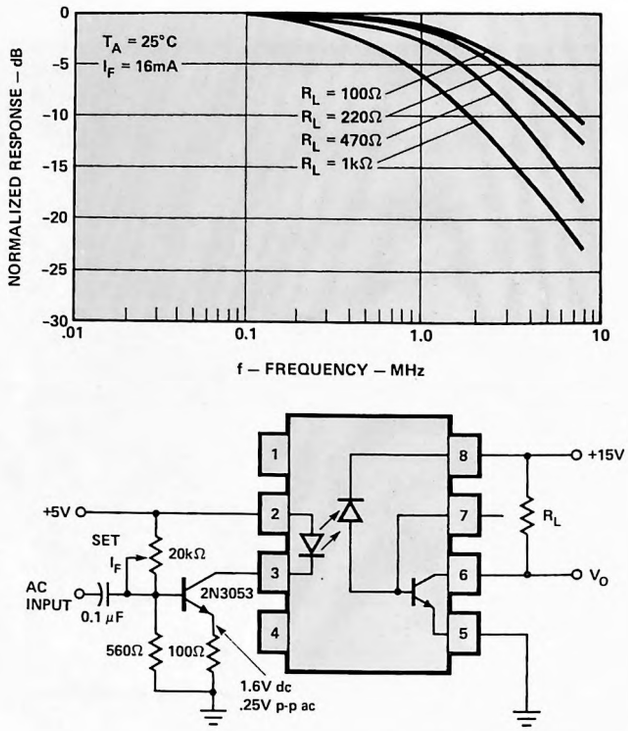


Figure 8. Frequency Response.

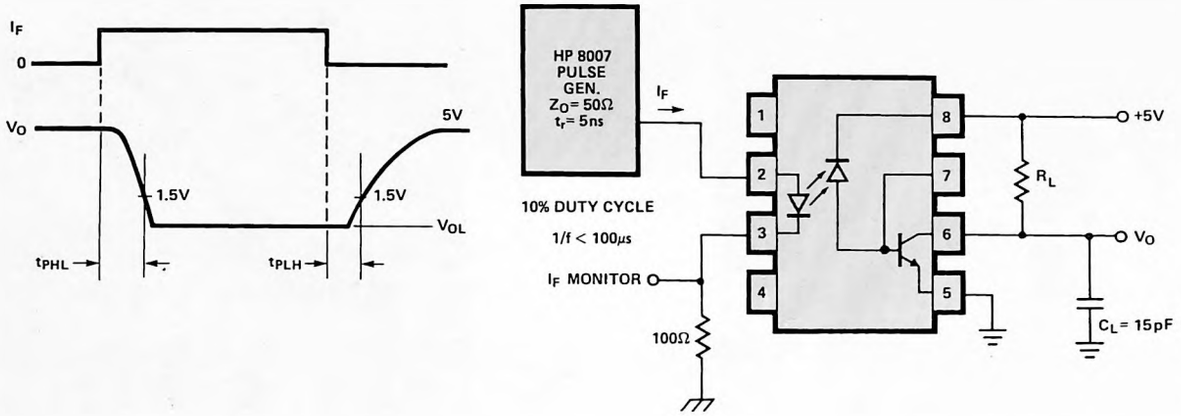


Figure 9. Switching Test Circuit.

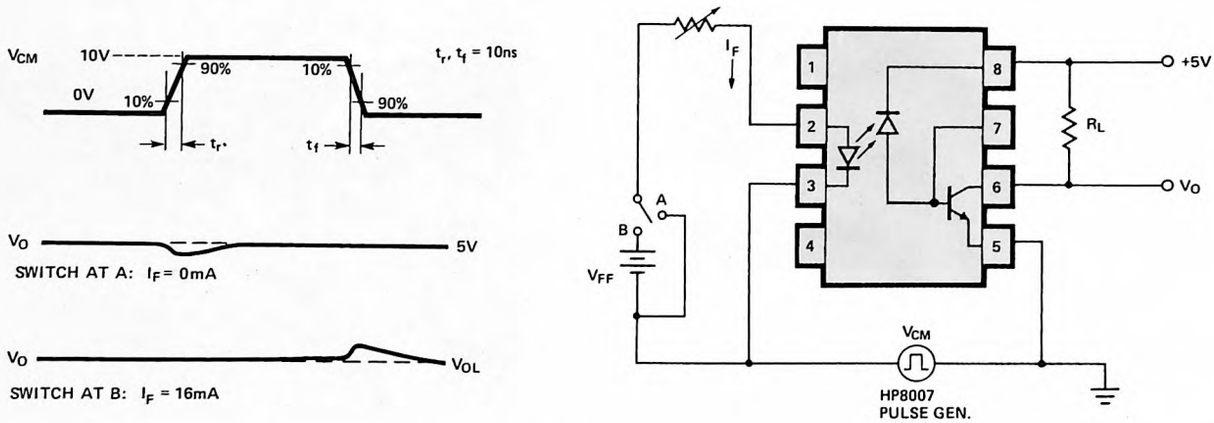


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

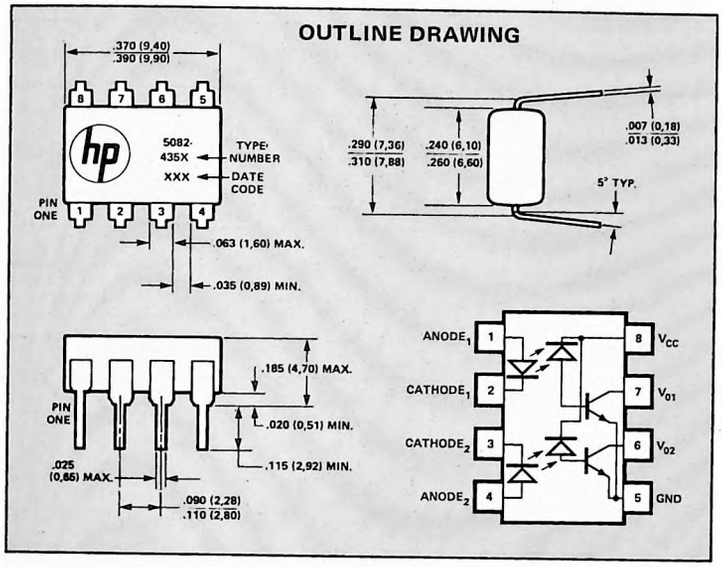
HEWLETT hp PACKARD

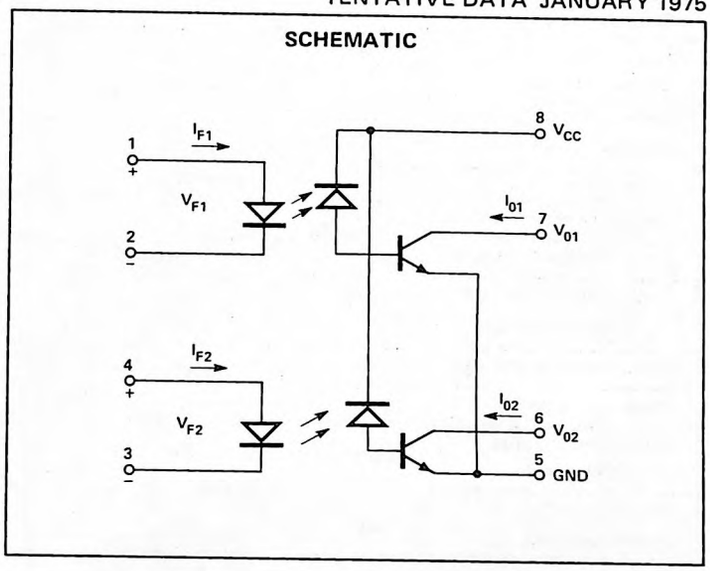
COMPONENTS

DUAL HIGH SPEED OPTICALLY COUPLED ISOLATORS

5082-4354
5082-4355

TENTATIVE DATA JANUARY 1975





Features

- **High Speed — 1 Mbit/s**
- **TTL Compatible**
- **High Common Mode Transient Immunity — >1000V/μs**
- **High Density Packaging**
- **2500V dc Insulation Voltage**
- **3 MHz Bandwidth**
- **Open Collector Outputs**

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/μs) allows use of low cost twisted pair cable instead of coax.
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.
- **Polarity Sensing.**
- **Isolated Analog Amplifier** — Dual channel packaging enhances thermal tracking.

Description

The 5082-4354/55 dual isolators contain a pair of light emitting diodes and integrated photon detectors with 2500V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collectors improve the speed up to a hundred times that of a conventional phototransistor isolator by reducing the base-collector capacitance.

The 5082-4354 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -4354 is 7% minimum for I_F = 16 mA.

The 5082-4355 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6kΩ pull-up resistor. CTR of the -4355 is 15% minimum at I_F = 16 mA.

Absolute Maximum Ratings

Storage Temperature . . . . . -55°C to +125°C
Operating Temperature . . . . . -55°C to +100°C
Lead Solder Temperature . . . . . 260°C for 10Sec
(1/16" below seating plane)
Average Input Current — I_F (each channel) . . . . . 25mA[1]
Peak Input Current — I_F (each channel) . . . . . 50mA[2]
(50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F (each channel) . . . . 1.0 A
(≤1μsec pulse width, 300pps)
Reverse Input Voltage — V_R (each channel) 5V
Input Power Dissipation (each channel) . . . . . 45mW[3]
Average Output Current — I_O (each channel) 8mA
Peak Output Current — I_O (each channel) 16mA
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 7,6-5)
. . . . . -0.5V to 15V
Output Power Dissipation (each channel) . . . . . 35mW[4]

See notes, page 2.

Electrical Specifications AT T_A = 25°C

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4354	7	18		%	I_F = 16mA, V_O = 0.4V, V_{CC} = 4.5V	2	5,6
		4355	15	22		%			
Logic Low Output Voltage	V_{OL}	4354		0.1	0.4	V	I_F = 16mA, I_O = 1.1mA, V_{CC}=4.5V		5
		4355		0.1	0.4	V	I_F = 16mA, I_O = 2.4mA, V_{CC}=4.5V		
Logic High Output Current	I_{OH}			3	500	nA	I_F = 0mA, V_O = V_{CC} = 5.5V	6	5
Logic High Output Current	I_{OH}				100	μA	I_F = 0mA, V_O = V_{CC} = 15V		5
Logic Low Supply Current	I_{CCL}			32		μA	I_{F1} = I_{F2} = 16mA V_{O1} = V_{O2} = Open, V_{CC} = 15V		
Logic High Supply Current	I_{CCH}			0.05	2	μA	I_{F1} = I_{F2} = 0mA V_{O1} = V_{O2} = Open, V_{CC} = 15V		
Input Forward Voltage	V_F			1.5	1.7	V	I_F = 16mA	3	5
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I_F = 16mA		5
Input Reverse Voltage	V_R		5			V	I_F = 10μA		5
Input Capacitance	C_O			40		pF	f = 1 MHz, V_F = 0		5
Insulation Voltage (Input-Output)	V_{I-O}		2500			V dc	45% Relative Humidity		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500V dc		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f = 1 MHz		7
Insulation Voltage (Input-Input)	V_{I-I}			1500		V	45% Relative Humidity		8
Resistance (Input-Input)	R_{I-I}			10^{11}		Ω	V_{I-I} = 500V dc		8
Capacitance (Input-Input)	C_{I-I}			0.25		pF	f = 1 MHz		8

Switching Specifications AT T_A = 25°C, V_{CC} = 5V, I_F = 16mA, UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4354		0.3	1.5	μs	R_L = 4.1 kΩ	5,9	10,11
		4355		0.2	0.8	μs	R_L = 1.9kΩ		
Propagation Delay Time to Logic High at Output	t_{PLH}	4354		0.4	1.0	μs	R_L = 4.1 kΩ	5,9	10,11
		4355		0.3	0.8	μs	R_L = 1.9 kΩ		
Common Mode Transient Immunity at Logic High Level Output	CM_H	4354		>1000		V/μs	I_F =0mA, R_L=4.1 kΩ, V_{CM}=10V_{p-p}	10	9,10,11
		4355		>1000		V/μs	I_F=0mA, R_L=1.9kΩ, V_{CM}=10V_{p-p}		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	4354		<-1000		V/μs	V_{CM}=10V_{p-p}, R_L = 4.1kΩ	10	9,10,11
		4355		<-1000		V/μs	V_{CM} = 10V_{p-p}, R_L = 1.9kΩ		
Bandwidth	BW			3		MHz	R_L = 100Ω	8	12

NOTES:
1. Derate linearly above 70°C free-air temperature at a rate of 0.8mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 1.0mW/°C.
5. Each channel.
6. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.
9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM}, to assure that the output will remain in a Logic High state (i.e., V_O > 2.0V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., V_O < 0.8V).
10. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and the 5.6kΩ pull-up resistor.
11. The 4.1kΩ load represents 1 LTTL unit load of 0.18mA and 5.6kΩ pull-up resistor.
12. The frequency at which the ac output voltage is 3dB below the low frequency asymptote.

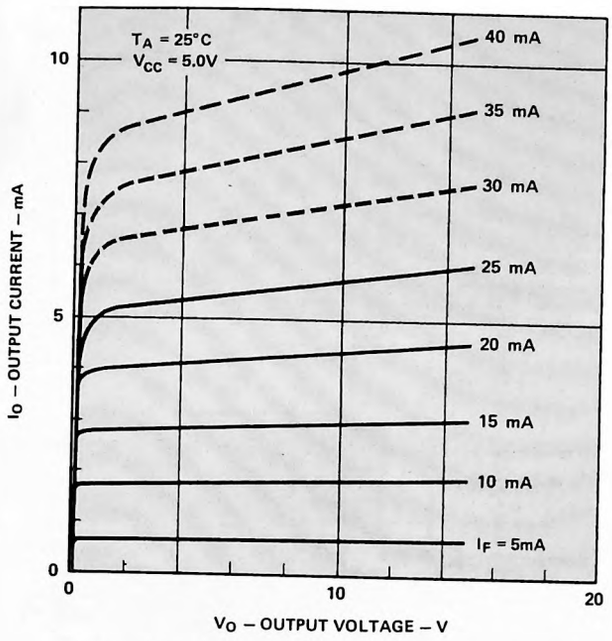


Figure 1. DC and Pulsed Transfer Characteristics.

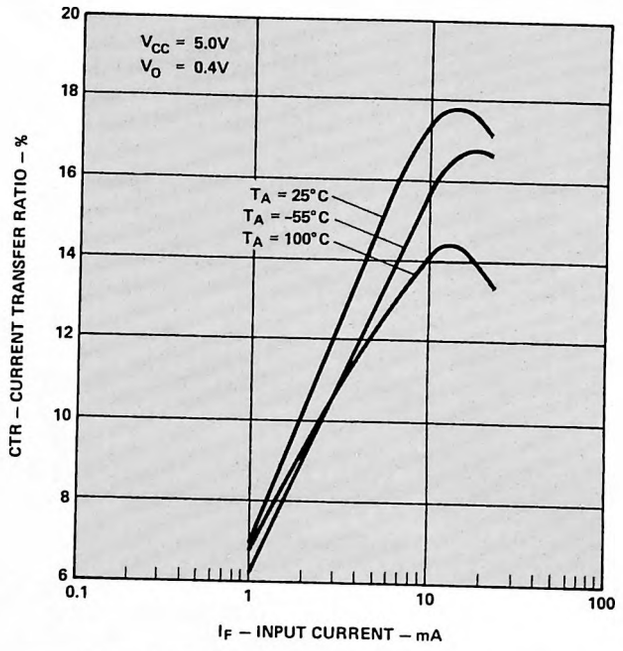


Figure 2. Current Transfer Ratio vs. Input Current.

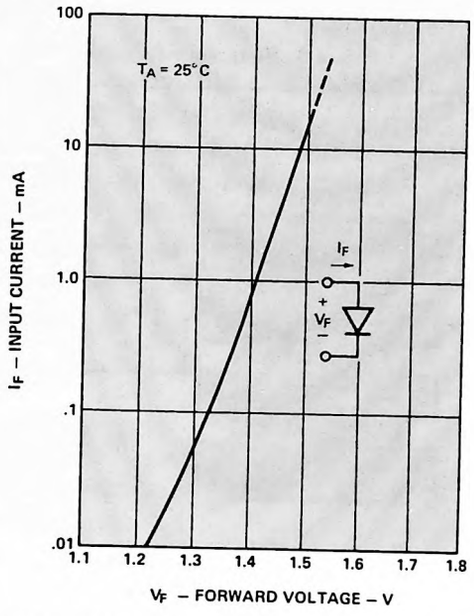


Figure 3. Input Current vs. Forward Voltage.

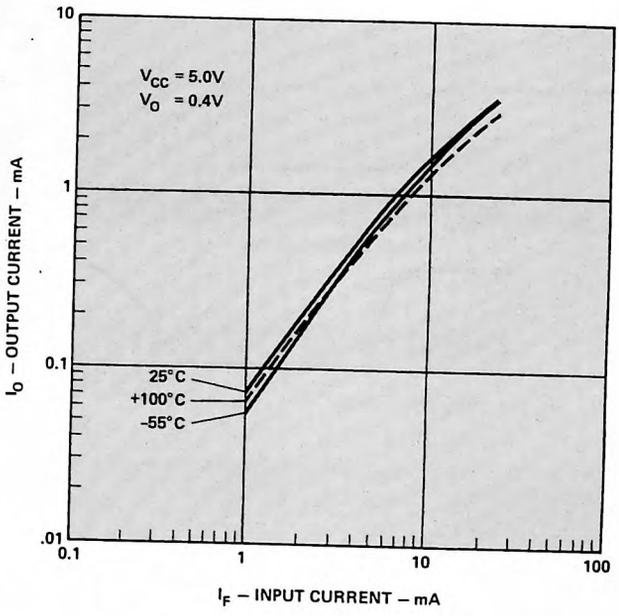


Figure 4. Output Current vs. Input Current.

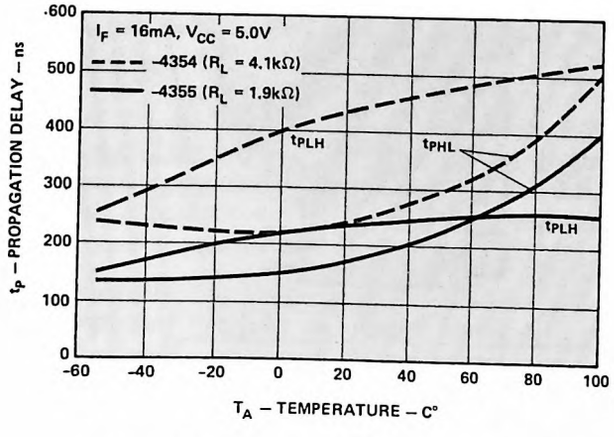


Figure 5. Propagation Delay vs. Temperature.

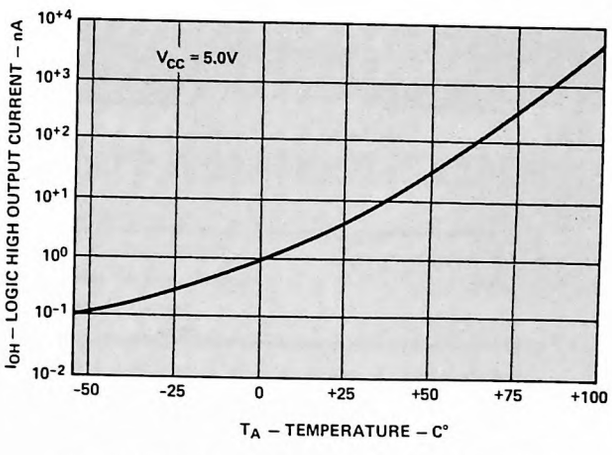


Figure 6. Logic High Output Current vs. Temperature.

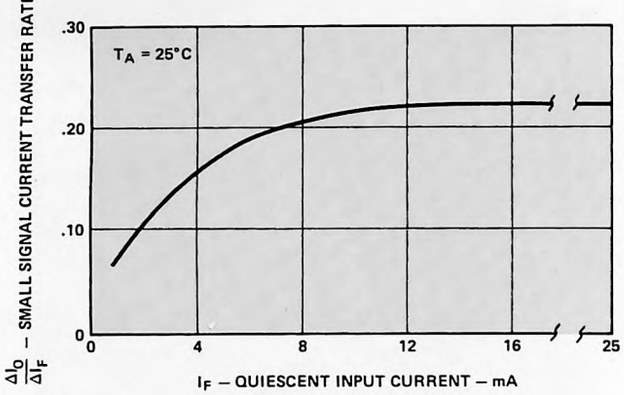


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

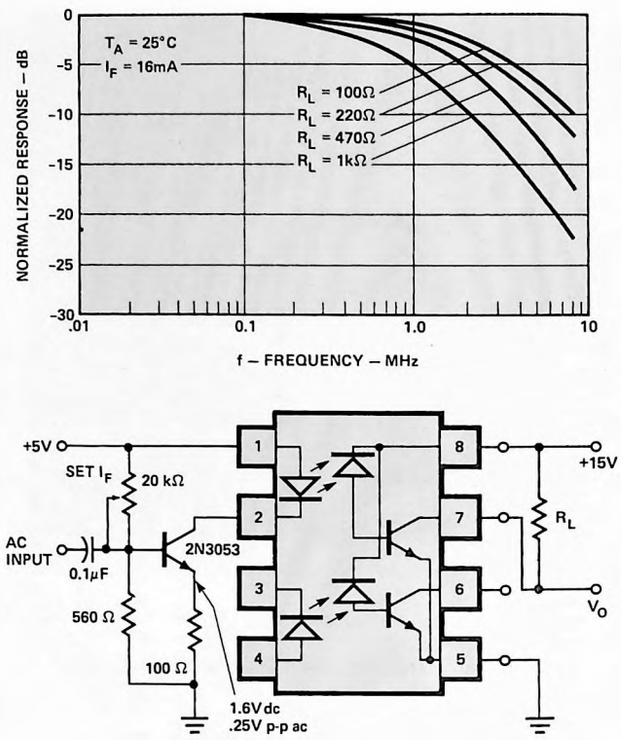


Figure 8. Frequency Response.

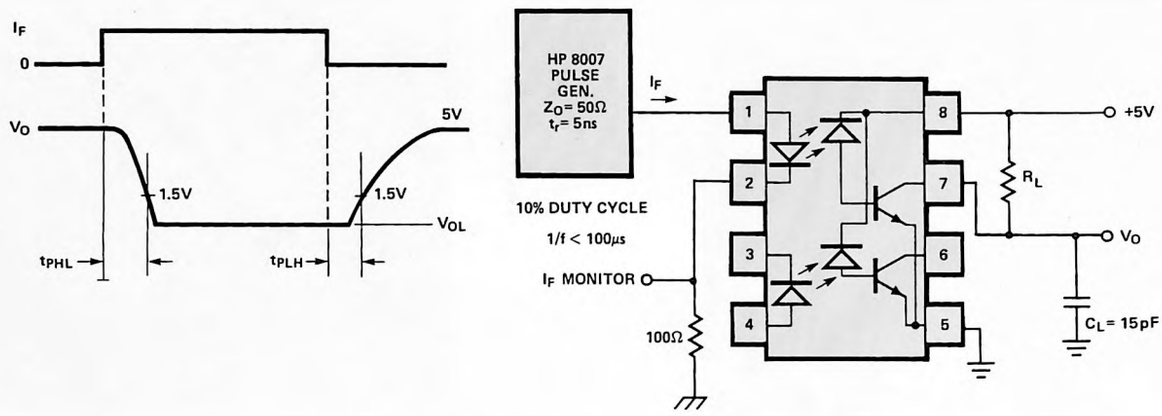


Figure 9. Switching Test Circuit.

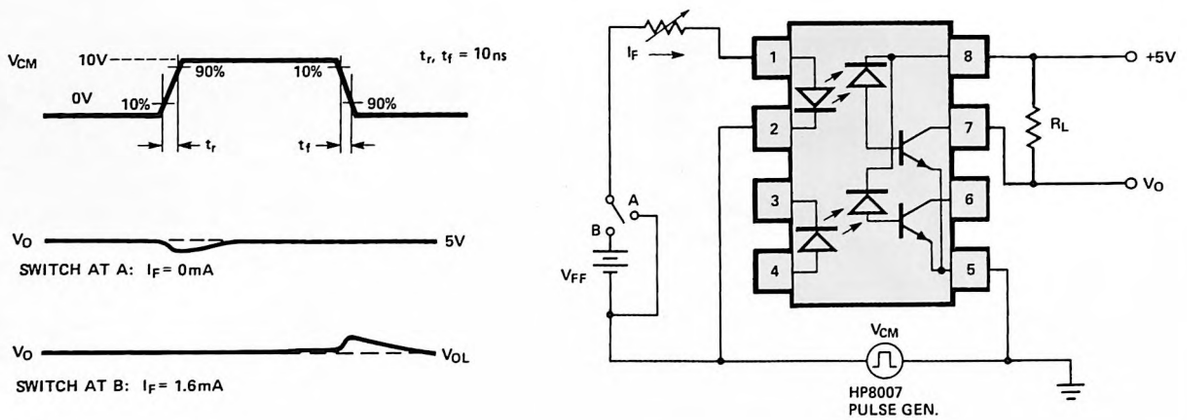


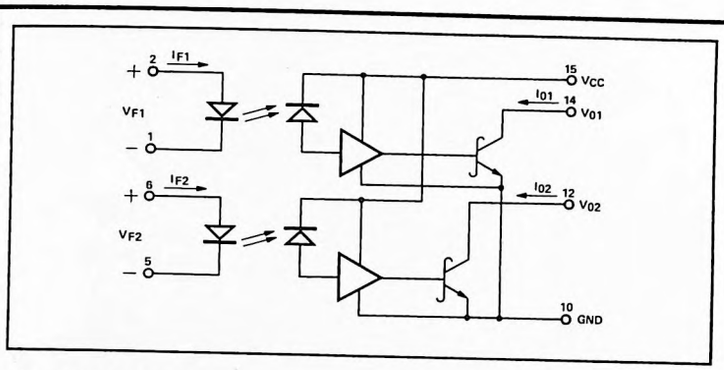
Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

HEWLETT hp PACKARD
COMPONENTS

DUAL CHANNEL HERMETICALLY SEALED OPTICALLY COUPLED ISOLATOR

582-4365
TX-4365
TXB-4365

TECHNICAL DATA JANUARY 1975



Features

- Hermetically Sealed
- High Speed
- Performance Guaranteed Over −55°C to +125°C Ambient Temperature Range
- High Reliability Screening Program Available
- TTL Compatible Input and Output
- High Common Mode Rejection
- Dual-In-Line Package
- 1500V Insulation Voltage
- Dual Channel

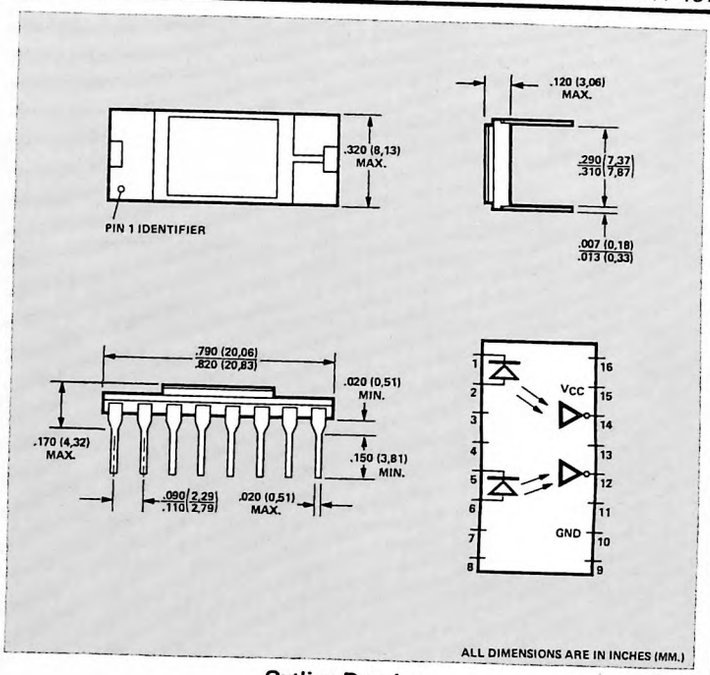
Applications

- Logic Ground Isolation
- Line Receiver
- Computer - Peripheral Interface
- High Density Packaging
- High Reliability Systems

Description

The 5082-4365 consists of a pair of inverting optically isolated gates, each with a light emitting diode and a unique high gain integrated photon detector in a hermetically sealed ceramic package. The output of the detector is an open collector Schottky clamped transistor.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving TTL circuit compatibility. The isolator operational parameters are guaranteed from -55°C to +125°C, such that a minimum input current of 10 mA in each channel will sink a six gate fanout (10 mA) at the output with 4.5 to 5.5 V V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 55 nsec.



Outline Drawing

Recommended Operating Conditions

TABLE I

	Sym.	Min.	Typ.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0		250	μA
Input Current, High Level Each Channel	I_{FH}	10	13	20	mA
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Fan Out (TTL Load) Each Channel	N			6	
Operating Temperature	T_A	−55	25	125	°C

Absolute Maximum Ratings

Storage Temperature . . . . . −65°C to +150°C
Operating Temperature . . . . . −55°C to +125°C
Lead Solder Temperature . . . . . 260°C for 10 Sec.
Peak Forward Input Current (each channel) . . . . . 40 mA (⩽1 msec Duration)
Average Input Forward Current (each channel) . . . . . 20 mA
Reverse Input Voltage (each channel) 5V
Supply Voltage - V_{CC} 7V
Output Current - I_O (each channel) . . . . . 25 mA
Output Power Dissipation (each channel) . . . . . 40 mW
Output Voltage - V_O (each channel). 7V

TABLE II, GROUP A

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE (T_A = −55°C TO +125°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		1	250	μA	V_{CC} = 5.5V, V_O = 5.5V, I_F = 250μA		1
Low Level Output Voltage	V_{OL}		0.5	0.6	V	V_{CC} = 5.5V, I_F = 10mA I_{OL} (Sinking) = 10mA		1
High Level Supply Current	I_{CCH}		14	20	mA	V_{CC} = 5.5V, I_F = 0 Each Channel		
Low Level Supply Current	I_{CCL}		26	36	mA	V_{CC} = 5.5V, I_F = 20mA Each Channel		
Input Forward Voltage	V_F		1.5	1.75	V	I_F = 20mA, T_A = 25°C	1	1
Input Reverse Breakdown Voltage	BV_R	5			V	I_R = 10μA, T_A = 25°C		
Input Capacitance	C_{in}		60		pF	V_F = 0, f = 1MHz		1
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.9		mV/°C	I_F = 20mA		1
Insulation Voltage (Input-Output)	V_{I-O}	1500			V_{dc}	Relative Humidity = 45% T_A = 25°C		2
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O} = 500V		3
Capacitance (Input-Output)	C_{I-O}		1.7		pF	f = 1MHz		3
Insulation Voltage (Input-Input)	V_{I-I}		1500		V_{dc}	Relative Humidity = 45%		4
Resistance (Input-Input)	R_{I-I}		10^{12}		Ω	V_{I-I} = 500V		4
Capacitance (Input-Input)	C_{I-I}		0.55		pF	f = 1MHz		4

*All typical values are at V_{CC} = 5V, T_A = 25°C

TABLE III

Switching Characteristics AT T_A = 25°C, V_{CC} = 5V EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		65	90	ns	R_L = 510Ω, C_L = 15pF, I_F = 13mA	2,3	5
Propagation Delay Time to Low Output Level	t_{PHL}		55	90	ns	R_L = 510Ω, C_L = 15pF I_F = 13mA	2,3	6
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	R_L = 510Ω, C_L = 15pF I_F = 13mA		
Common Mode Transient Immunity at High Output Level	CM_H		250		V/μs	V_{CM} = 10V (peak), V_O (min.) = 2V, R_L = 510Ω, I_F = 0mA	6	7
Common Mode Transient Immunity at Low Output Level	CM_L		−750		V/μs	V_{CM} = 10V (peak), V_O (max.) = 0.8V, R_L = 510Ω, I_F = 10mA	6	8

NOTES:

1. Each channel.
2. Measured between pins 1 through 8 shorted together and pins 9 through 16 shorted together.
3. Measured between pins 1 and 2 or 5 and 6 shorted together, and pins 9 through 16 shorted together.
4. Measured between pins 1 and 2 shorted together, and pins 5 and 6 shorted together.
5. The t_{PLH} propagation delay is measured from the 6.5mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
6. The t_{PHL} propagation delay is measured from the 6.5mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
7. CM_H is the max. tolerable common mode transient to assure that the output will remain in a high logic state (i.e., $V_O > 2.0V$).
8. CM_L is the max. tolerable common mode transient to assure that the output will remain in a low logic state (i.e., $V_O < 0.8V$).
9. It is essential that a by-pass capacitor (.01μF minimum, ceramic) be connected from pin 10 to pin 15, as close to the device as possible.

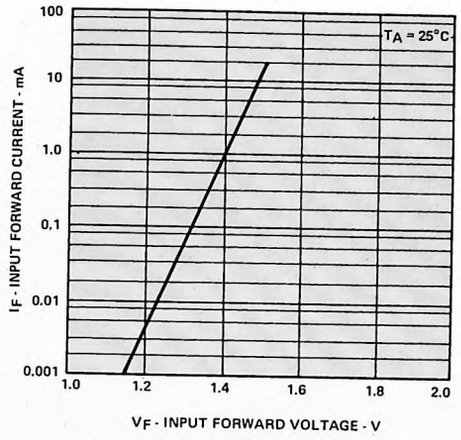


Figure 1. Input Diode Forward Characteristic

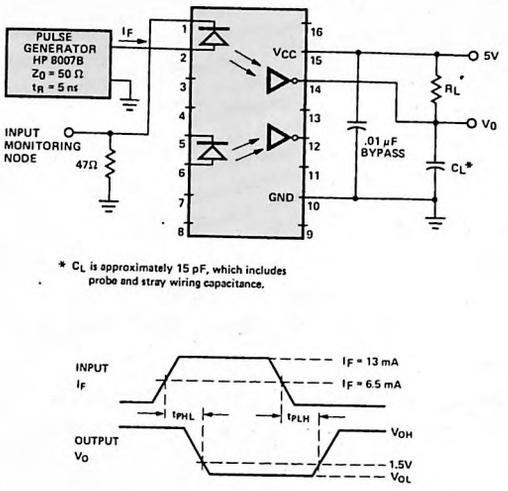


Figure 2. Test Circuit for t_{PHL} and t_{PLH}

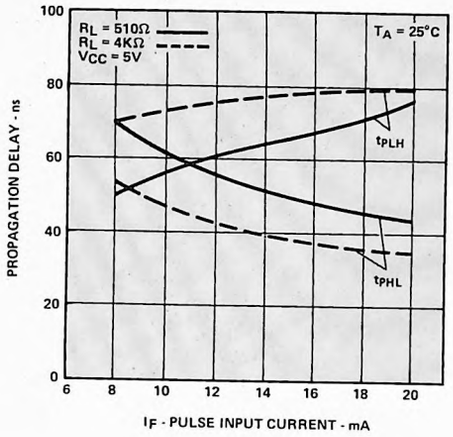


Figure 3. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}

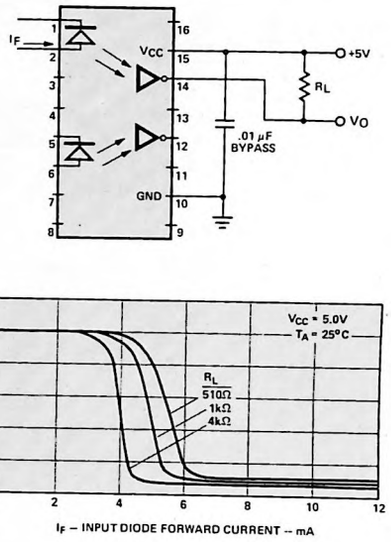


Figure 4. Input-Output Characteristics

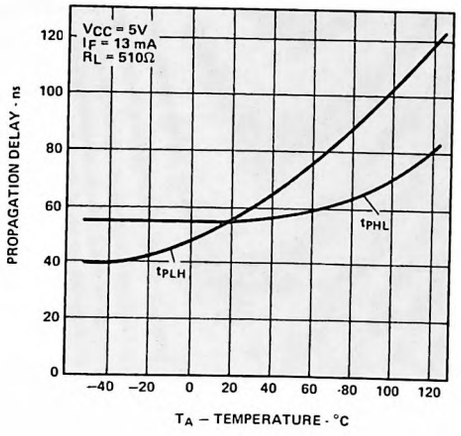


Figure 5. Propagation Delay vs. Temperature

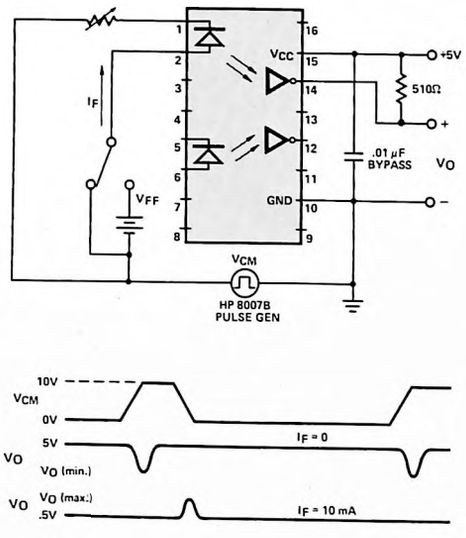


Figure 6. Typical Common Mode Rejection Characteristics/Circuit

High Reliability Test Program

Hewlett Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

- The TX prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXB prefix identifies a part which has been preconditioned and screened per Table IV, and comes from a lot which has been subjected to the Group B tests detailed in Table V.

Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-4365	TX-4365	TXB -4365

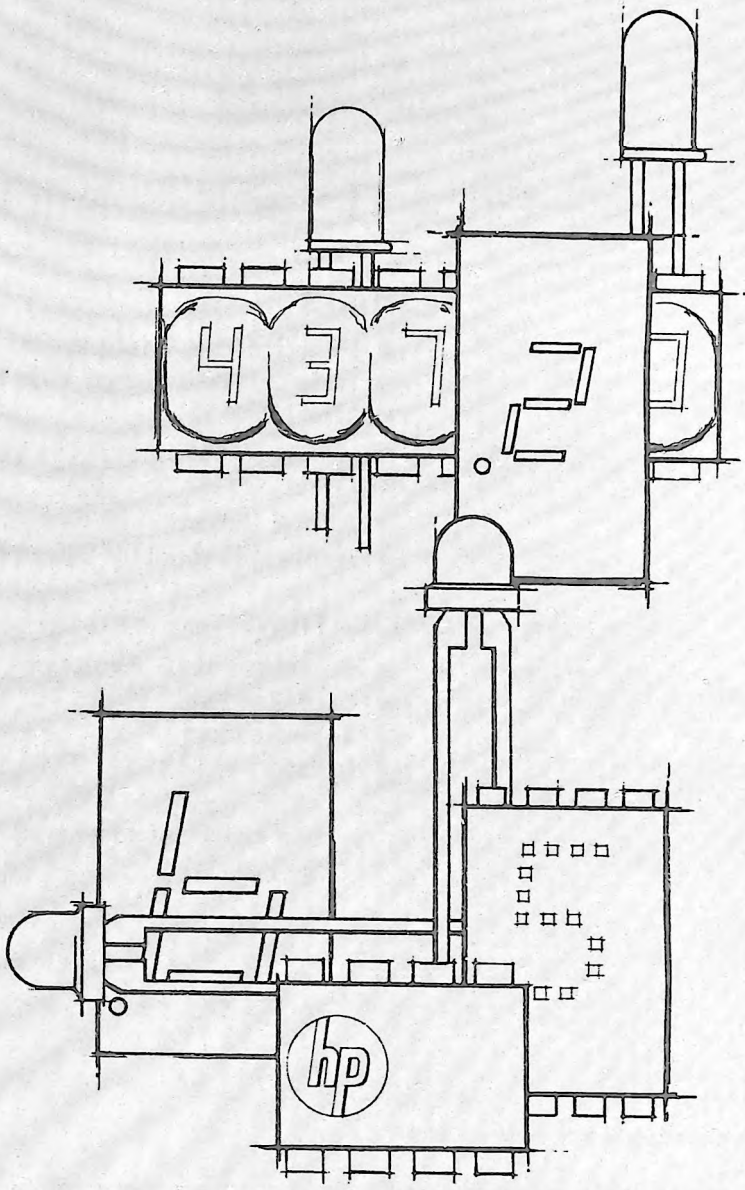
TABLE IV TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-883 Methods	Conditions
1. Pre-Cap Visual Inspection	HPA Procedure 72-4065	
2. Electrical Test: Group A*, Table II, 100%, $T_A = 25°C$		
3. High Temperature Storage	1008	168 hrs. @ 150°C
4. Temperature Cycling	1010	-65°C to +150°C
5. Acceleration	2001	20KG, Y_1
6. Helium Leak Test	1014	Cond. A
7. Gross Leak Test	1014	Cond. C, Step 1
8. Electrical Test; read V_{OL} per Table II, $T_A = 25°C$		
9. Burn-In, $V_{CC} = 5.5V$, $I_F = 13mA$, $I_O = 25mA$	1015	168 hrs. @ $T_A = 25°C$
10. Electrical Test: Group A*, Table II		
11. Evaluate drift		Max. $\Delta V_{OL} = \pm 20\%$

*Min/Max guaranteed parameters only.

TABLE V, GROUP B

Examination or Test	MIL-STD-883 Method	MIL-STD-883 Condition	LTPD
Subgroup 1			15
Physical Dimensions	2008	See Product Outline Drawing	
Subgroup 2			20
Solderability	2003	Immersion within 0.10" of body, 8 terminations	
Subgroup 3			15
Temperature Cycling	1010	Test Condition B	
Thermal Shock	1011	Test Condition A, 5 cycles	
Hermetic Seal, Fine Leak	1014	Test Condition A	
Hermetic Seal, Gross Leak	1014	Test Condition C, Step 1	
End Points: Group A		Per Table II, $T_A = 25°C$	
Subgroup 4			15
Shock, non-operating	2002	1500 G, t = 0.5 ms, 5 blows in each orientation X_1, Y_1, Y_2	
Constant Acceleration	2001	20KG, Y_1	
End Points: Same as Subgroup 3			
Subgroup 5			15
Terminal Strength, tension	2004	Test Condition A, 1 lb., 15 sec.	
Subgroup 6			
High Temperature Life	1008	$T_A = 125°C$, non-operating	$\lambda = 7$
End Points: Per Step 8, Table IV			
Drift Criteria: Per Step 11, Table IV			
Subgroup 7			
Steady State Operating Life	1005	$V_{CC} = 5.5V$, $I_F = 13mA$, $I_O = 25mA$,	$\lambda = 7$
End Points: Same as Subgroup 6		$T_A = 25°C$	



Photodetectors

Selection Guide 112
PIN Photodiodes, 5082-4200 Series 113

Photodetectors (PIN Photodiodes)

FEATURES

- High Speed — 1 ns Speed of Response
- Wide Dynamic Range — dc to 1 GHz
- Low Noise

BENEFITS

- Allows Detection of Fast Light Sources, e.g., Lasers
- Applicable to Many Different Light Sources

APPLICATIONS

- Detection of IR Radiation
- Card Readers
- Tape Readers
- Isolators

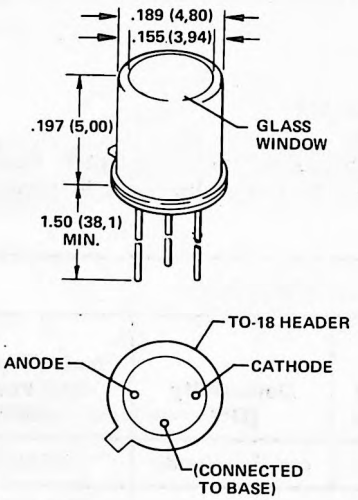
(For further information ask for Application Note 915.
See page 117.)

HEWLETT hp PACKARD
COMPONENTS

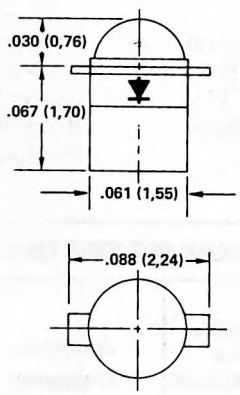
PIN PHOTODIODE

5082-4200 SERIES

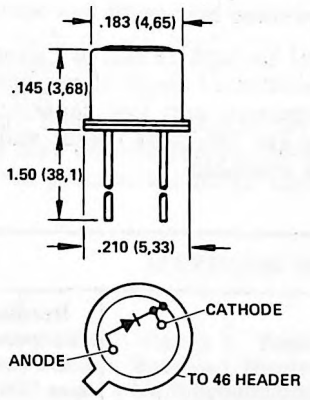
TECHNICAL DATA SEPT 72



HP 5082-4203, -4204, -4207



HP 5082-4205



HP 5082-4220

All dimensions in inches and (millimeters)

The HP silicon planar PIN photodiodes are ultrafast light detectors for visible and near infrared radiation. Their response to blue and violet is unusually good for low dark current silicon photodiodes.

The speed of response of these detectors is less than one nanosecond. Laser pulses shorter than 0.1 nanosecond may be observed. The frequency response extends from dc to 1 GHz.

The low dark current of these planar diodes enables detection of very low light levels. The quantum detection efficiency is constant over six decades of light intensity, providing an excellent dynamic range.

The 5082-4203, -4204, and -4207 are packaged on a standard TO-18 header with a plane glass window cap. For versatility of circuit connection, they are electrically insulated from the header. The light sensitive area of the 5082-4203 and -4204 is 0.020 inch (0,508 mm) in diameter and is located 0.075 inch (1,905 mm) behind the window. The light sensitive area of the 5082-4207 is 0.040 inch (1,016 mm) in diameter and is also located 0.075 inch (1,905 mm) behind the window.

The 5082-4205 is in a low capacitance Kovar and ceramic package of very small dimensions, with a hemispherical lens.

The 5082-4220 is packaged on a TO-46 header with the 0.020 inch (0,508 mm) diameter sensitive area located 0.100 inch (2,540 mm) behind a flat glass window.

NOISE FREE PROPERTIES

The noise current of the PIN diodes is negligible. This is a direct result of the exceptionally low leakage current, in accordance with the shot noise formula $I_N = (2qI_R\Delta f)^{1/2}$. Since the leakage current does not exceed 400 picoamps for the 5082-4204 at a reverse bias of 10 volts, shot noise current is less than 1.2×10^{-14} amp $Hz^{-1/2}$ at this voltage.

Excess noise is also very low, appearing only at frequencies below 10 Hz, and varying approximately as 1/f. When the output of the diode is observed in a load, thermal noise of the load resistance (R_L) is 1.28×10^{-10} $(R_L)^{-1/2} \times (\Delta f)^{1/2}$ at 25°C, and far exceeds the diode shot noise for load resistances less than 100 megohms (see Figure 6). Thus in high frequency operation where low values of load resistance are required for high cut-off frequency, all PIN photodiodes contribute virtually no noise to the system (see Figures 6 and 7).

Ultra-fast operation is possible because the HP PIN photodiodes are capable of a response time less than one nanosecond. A significant advantage of the device is that this great speed of response is exhibited at relatively low reverse bias (−10 to −20 volts).

Because of its high sensitivity over a wide spectral range, unprecedented speed of response, unrivaled low-noise performance, and low capacitance, the HP PIN photodiodes are the most useful and versatile silicon photodiodes available.

NOTES:

1. Peak Pulse Power
   When exposing the diode to high level irradiance the following photocurrent limits must be observed:

$$I_P \text{ (avg)} < \frac{0.1}{E_P}$$

   and

$$I_P \text{ (peak)} < 500 \text{ mA} \quad \text{or}$$

$$< \frac{1000 \text{ Amps}}{t(\mu\text{sec})} \quad \text{or}$$

$$< \frac{I_p \text{ (avg)}}{ft}$$

   whichever of the above three conditions is least.
   I_P—photocurrent
   E_P—supply voltage
   t—pulse duration
   f—pulse repetition rate
2. Current Responsivity
   Response of the photodiode to a uniform field of irradiance H, parallel to the polar axis is given by

OPTICAL CHARACTERISTICS AT 25°C

Characteristics		Irradiance Response at 770 nm (1) (RA)	Sensitive Area (A)	Junction Diameter		Speed of Response	Detectivity (D*)	Noise Equivalent Power (NEP)
Units		μA/mW/cm^2	cm^2	Inches	mm	nsec	cm Hz$^{1/2}$/watt	W Hz$^{-1/2}$
Test Conditions		V = −20 R_L = 1 MΩ				V = −20 R_L = 50Ω	(0.8, 100, 6) (λ, f, Δf)	(0.8, 100, 6) (λ, f, Δf)
5082-4203	Min.						0.9×10^{12}	
	Typ.	1.0	2×10^{-3}	0.020	0,508	<1		
	Max.							5.1×10^{-14}
5082-4204	Min.						4.1×10^{12}	
	Typ.	1.0	2×10^{-3}	0.020	0,508	<1		
	Max.							1.2×10^{-14}
5082-4205	Min.						3.95×10^{12} (2)	
	Typ.	1.5 (2)	3×10^{-3} (2)	0.010	0,254	<1		
	Max.							1.4×10^{-14}
5082-4207	Min.						2.5×10^{12}	
	Typ.	4.0	8×10^{-3}	0.040	1,016	<1		
	Max.							3.6×10^{-14}
5082-4220	Min.						0.57×10^{12}	
	Typ.	1.0	2×10^{-3}	0.020	0,508	<1		
	Max.							8×10^{-14}

NOTES:

(1) Response at 770 nm may be described as a RESPONSIVITY, R ≈ 0.5 μA/μW corresponding to a quantum efficiency, $\eta \approx 0.75$ electron/photon (see Figure 1).
(2) Specification includes lens effect.

$I = (RA) \times H$ for 770 nm. The response from a field not parallel to the axis can be found by multiplying (RA) by a normalizing factor obtained from the radiation pattern at the angle in question. For example, the multiplying factor for the 5082-4207 with irradiance H, at an angle of 40° from the polar axis is 0.8. If $H = 1\ mW/cm^2$, then $I = k \times (RA) \times H$; $I = 0.8 \times 4.0 \times 1 = 3.2\ \mu amps$.

To obtain the response at a wavelength other than 770 nm, the relative spectral response must be considered. Referring to the spectral response curve, Figure 1, obtain response, X, at the wavelength desired. Then the ratio of the response at the desired wavelength to response at 770 nm is given by:

$$\text{Ratio} = \frac{X}{0.5}$$

Multiplying this ratio by the current response at 770 nm will give the current response at the desired wavelength.

3. 5082-4205 Mounting Recommendations
   a. The 5082-4205 is intended to be soldered to a printed circuit board having a thickness of from 0.020 to 0.060 inch (0,051 to 0,152 cm).
   b. Soldering temperature should be controlled so that at no time does the case temperature approach 280°C. The lowest solder melting point in the device is 280°C (gold-tin eutectic). If this temperature is approached, the solder will soften, and the lens may fall off. Lead-tin solder is recommended for mounting the package, and should be applied with a small soldering iron, for the shortest possible time, to avoid the temperature approaching 280°C.
   c. Contact to the lens end should be made by soldering to one or both of the tabs provided. Care should be exercised to prevent solder from coming in contact with the lens.
   d. If printed circuit board mounting is not convenient, wire leads may be soldered or welded to the devices using the precautions noted above.

ELECTRICAL CHARACTERISTICS AT 25°C						MAXIMUM RATINGS			
Junction Capacitance		Capacitance to Shield		Dark Current		Series Resistance	Steady Reverse Voltage	Peak Inverse Voltage	Power Dissipation
pF	pF	pF	pF	pA	pA	Ω	Volts	Volts	mW
$V_R = -10$ V	$V_R = -25$ V	$V_R = -10$ V	$V_R = -25$ V	$V_R = -10$ V	$V_R = -25$ V				25°C
	1.5		2						
					2000	50	50	200	100
2.0		2							
				600		50	20	200	100
0.7		*							
				150		50	50	200	50
5.5		2							
				2500		50	20	200	100
2.0		*							
					5000	50	50	200	100

* Not isolated from header.

Exceeding the peak inverse voltage may cause permanent damage to the diode. Forward current is harmless to the diode, within the power dissipation limit. For optimum performance, the diode should be reverse biased at between 5 and 20 volts.

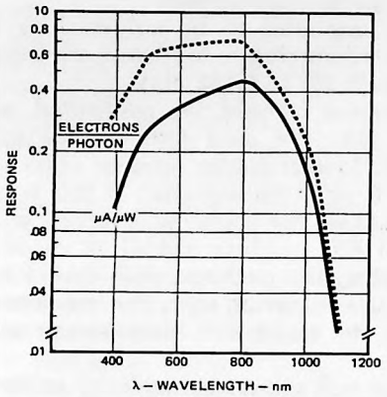


Figure 1. Spectral response.

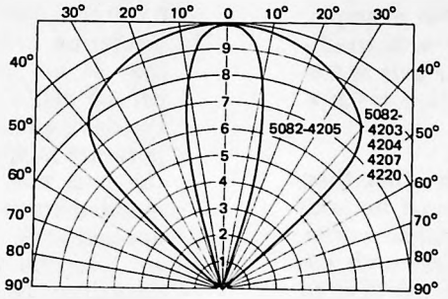


Figure 2. Relative directional sensitivity of the PIN Photodiodes.

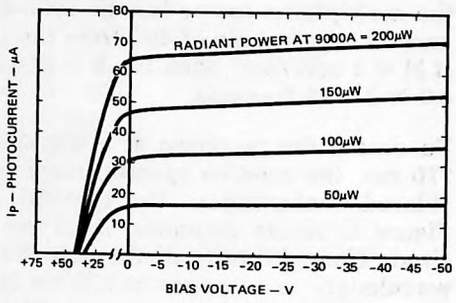


Figure 3. Typical output characteristics at $\lambda = 900$ nm.

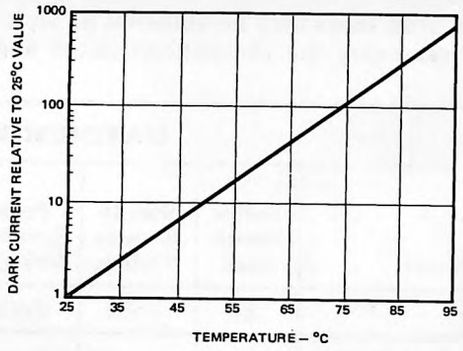


Figure 4. Dark current at −10 V bias vs. temperature.

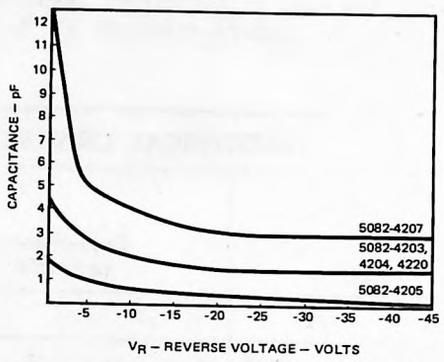


Figure 5. Typical capacitance variation with applied voltage.

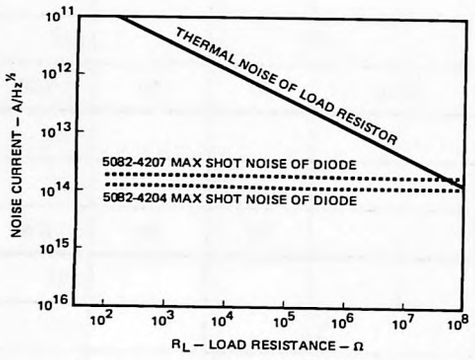

THERMAL NOISE OF LOAD RESISTOR
5082-4207 MAX SHOT NOISE OF DIODE
5082-4204 MAX SHOT NOISE OF DIODE
NOISE CURRENT – A/Hz½
RL – LOAD RESISTANCE – Ω

Figure 6. Noise vs. load resistance.

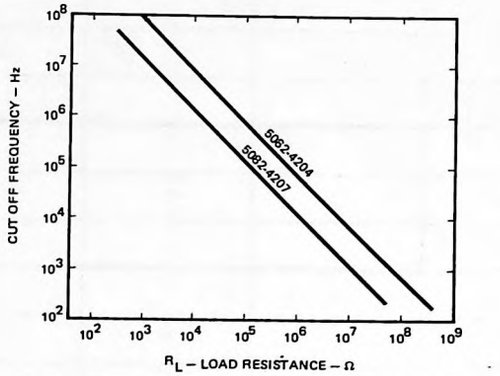


Figure 7. Photodiode cut-off frequency vs. load resistance (C = 2 pF).

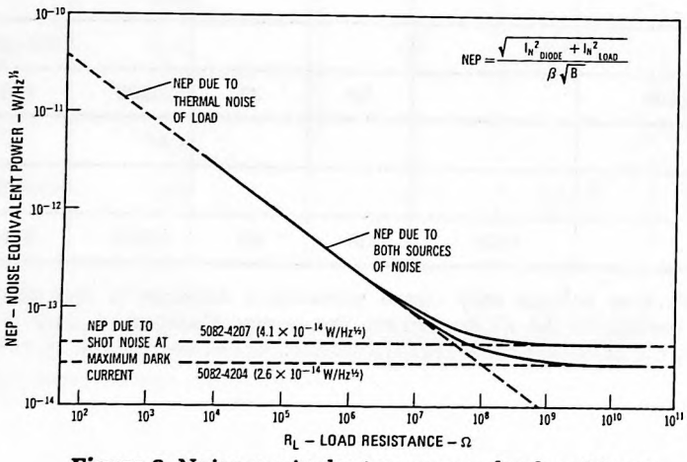


Figure 8. Noise equivalent power vs. load resistance.

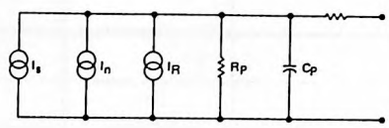


Figure 9.

i_s = Signal current ≈ 0.5 μA/μW × P input
i_n = Shot noise current
< 1.2×10^{-14} amps/Hz$^{1/2}$ (5082-4204)
< 4×10^{-14} amps/Hz$^{1/2}$ (5082-4207)
I_R = Dark current
< 600×10^{-12} amps at −10 V dc (5082-4204)
< 2500×10^{-12} amps at −10 V dc (5082-4207)
$R_P = 10^{11}\ \Omega$
$R_S = < 50\ \Omega$

Application Note Index

APPLICATION NOTE 915

Threshold Detection of Visible and Infrared Radiation with PIN Photodiodes

Traditionally, the detection and demodulation of extremely low level optical signals has been performed with multiplier phototubes. Because of this tradition, solid-state photodetectors are often overlooked even though they have a number of clear functional advantages and in some applications provide superior performance as well. Some of these advantages are summarized in this note and become even more apparent in the discussion following.

APPLICATION NOTE 931

Solid State Alphanumeric Display . . . Decoder/Driver Circuitry

Hewlett-Packard offers a series of solid state displays capable of producing multiple alphanumeric characters utilizing 5x7 dot arrays of GaAsP light emitting diodes (LED's). These 5x7 dot arrays exhibit clear, easily read characters. In addition, each array is X-Y addressable to allow for a simple addressing, decoding, and driving scheme between the display module and external logic.

Methods of addressing, decoding and driving information to such an X-Y addressable matrix are covered in detail in this application note. The note starts with a general definition of the scanning or strobing technique used for this simplified addressing and then proceeds to describe horizontal and vertical strobing. Finally, a detailed circuit description is given for a practical vertical strobing application.

APPLICATION NOTE 934

5082-7300 Series Solid State Display Installation Techniques

The 5082-7300 series Numeric/Hexadecimal Indicators are an excellent solution to most standard display problems in commercial, industrial and military applications. The unit integrates the display character and associated drive electronics in a single package. This advantage allows for space, pin and labor cost reductions, at the same time improving overall reliability.

The information presented in this note describes general methods of incorporating the -7300 into varied applications.

APPLICATION NOTE 937

Monolithic Seven Segment LED Display Installation Techniques

The Hewlett-Packard series of small endstackable monolithic GaAsP displays are designed for strobing, a drive method that allows time sharing of the character generator among the digits in a display.

This Application Note begins with an explanation of the strobing technique, followed by a discussion of the uses and advantages of the right hand and center decimal point products.

Several circuits are given for typical applications. Finally, a discussion of interfacing to various data forms is presented along with comments on mounting the displays.

APPLICATION NOTE 939

High Speed Optically Coupled Isolators

Often designers are faced with the problem of providing circuit isolation in order to prevent ground loops and common mode signals. Typical devices for doing this have been relays, transformers and line receivers. However, both relays and transformers are low speed devices, incompatible with modern logic circuits. Line receiver circuits are fast enough, but are limited to a common mode voltage of 3 volts. In addition, they do not protect very well against ground loop signals. Now Optically Coupled Isolators are available which solve most isolation problems.

This Application Note contains a description of Hewlett-Packard's high speed isolators, and discusses their applications in digital and analog systems.

APPLICATION NOTE 941

5082-7700 Series Seven Segment LED Display Applications

The HP 5082-7700 series of LED displays are available in both common anode and common cathode configurations. These single digit displays have been engineered to provide a high contrast ratio and a wide viewing angle.

This Application Note begins with DC drive techniques and circuits. Next is an explanation of the strobe drive technique and the resultant increase in device efficiency. This is followed by general strobing circuits and some typical applications such as clocks, calculators and counters.

Finally, information is presented on general operating conditions, including intensity uniformity, light output control as a function of ambient light, contrast enhancement and device mounting.

APPLICATION NOTE 945

Photometry of RED LEDs

Nearly all LEDs are used either as discrete indicator lamps or as elements of a segmented or dot-matrix display. As such, they are viewed directly by human viewers, so the primary criteria for determining their performance is the judgment of a viewer. Equipment for measuring LED light output should, therefore, simulate human vision.

This Application Note will provide answers to these questions:

1. What to measure (definitions of terms)
2. How to measure it (apparatus arrangement)
3. Whose equipment to use (criteria for selection)

APPLICATION NOTE 946

5082-7430 Series Monolithic Seven Segment Displays

The HP 5082-7430 series solid state displays are common cathode, 2 and 3 digit clusters capable of displaying numeric and selected alphabetic data. These GaAsP displays employ an integral magnification technique to increase both the character size and the luminous intensity of each monolithic digit. The resultant 0.11" (2,79mm) high character is viewable at distances of up to 5 feet when operated at as little as 0.5 mW per segment.

These displays are designed for strobed operation. In strobing, the decoder is timeshared among the digits in the display, which are illuminated one at a time.

Typical applications, such as an Electronic Stopwatch, a battery operated Event Counter and a Four Function Calculator are discussed in this note.

APPLICATION NOTE 948

Performance of the 5082-4350/51/60 Series of Isolators in Short to Moderate Length Digital Data Transmission Systems

Optically coupled isolators (opto-isolators) can function as excellent alternatives to integrated circuit line receivers in digital data transmission applications. Their major advantages consist of superior common-mode noise rejection and true ground isolation between the two subsystems.

This application note describes the basic design elements of a data transmission link and presents several examples of total systems that will be useful to systems designers at distances that range from 1 ft. to 300 ft. and have a moderate overall cost.

APPLICATION NOTE 951-1

Applications for Low Input Current, High Gain Optically Coupled Isolators

Optically coupled isolators are useful in applications where large common mode signals are encountered. Examples are: line receivers, logic isolation, power lines, medical equipment and telephone lines. This application note has at least one example in each of these areas for the 5082-4370 series high CTR isolators.

APPLICATION NOTE 964

Contrast Enhancement Techniques

This Application Note presents various criteria and techniques that a display engineer should consider to obtain optimum contrast enhancement for red, yellow and green LED displays. A representative list of filter manufacturers and available filters is given at the end of this discussion.

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